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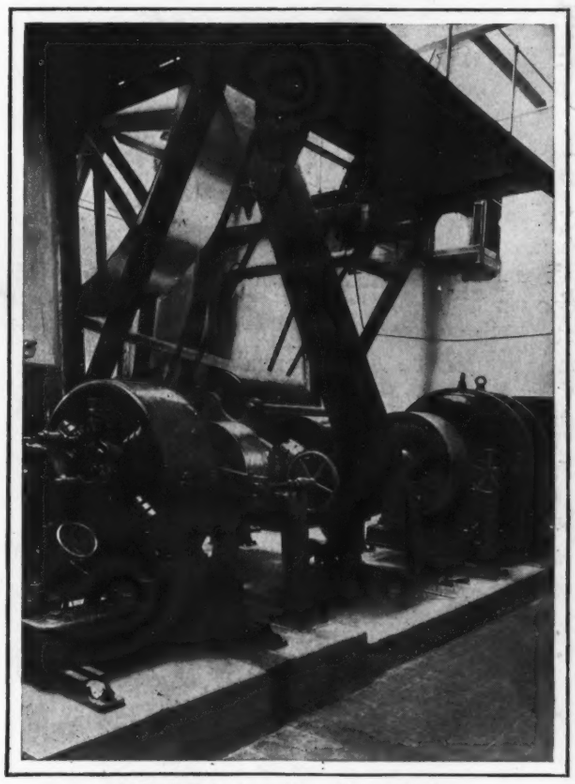

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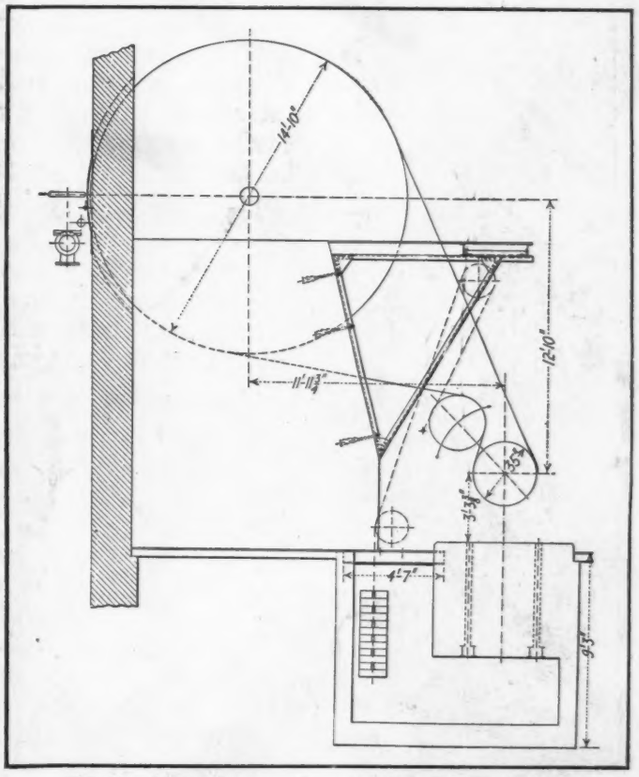

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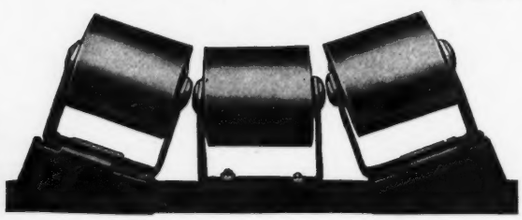

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Engineering and Mining Journal

VOLUME 102 SEPTEMBER 16, 1916 NUMBER 12

Nashwauk Iron-Washing Plants

By L. A. Rossman*

SYNOPSIS—Since the success of the Trout Lake concentrator, with a capacity of 40,000 tons of iron ore per day, has been demonstrated, a number of concentrators similar in design but of smaller capacity have been erected. At Nashwauk the four concentrators are operated by the M. A. Hanna, the Cleveland-Cliffs, the Wisconsin Steel and Butler Bros. companies. The process in general use is practically the same as that originally installed at the Trout Lake. Recently La Rue has installed Wetherbee concentrators to replace turbos and concentrating tables.

On the western part of the Mesabi Range there are great deposits of iron ore which contain a large amount of sand since the natural process of leaching or concentrating has not removed the silica from the ore. There are many millions of tons of this ore that can be easily and cheaply mined by the openpit method, but which have value only after it has been treated to remove much of the sand. To evolve a process that would remove this silica has taken years of experimentation. It was 12 or 15 years ago that a carload of ore from the Arcturus mine, near Marble, was sent to Georgia to be washed, and the results of this preliminary experiment being satisfactory, an experimental plant was built in 1905 by the Oliver Iron Mining Co., at Coleraine, in the Canisteo district. This was built under the supervision of John C. Greenway, now general superintendent of the Calumet & Arizona Copper Co. The experimental plant proving successful, a larger one was constructed in 1909 and this, the Trout Lake concentrator, has a capacity of close to 40,000 tons of crude ore a day.

At Nashwauk much of the ore is high in silica, and as a result, all the mining companies now operating have their own concentrating plants. The four operating companies at Nashwauk are: The M. A. Hanna Co., operating La Rue; the Cleveland-Cliffs interests, the Crosby; the Wisconsin Steel Co., the Hawkins; and Butler Bros., the Harrison. Practically all the ore is removed by the openpit method and nearly all of the production of these various mines is washed or concentrated. Three

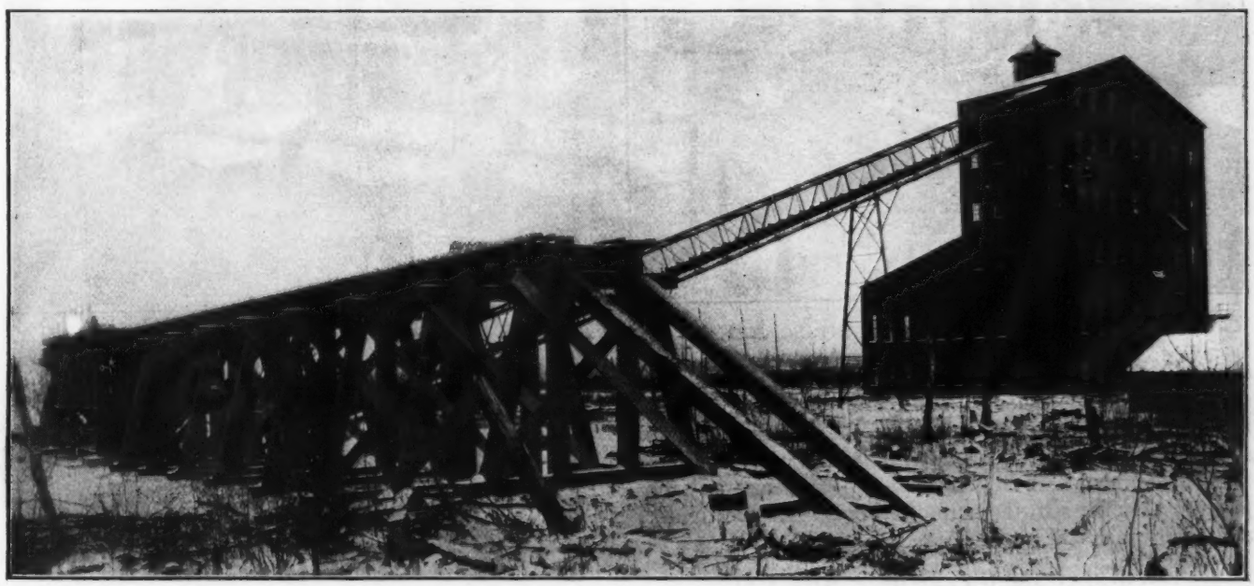


FIG. 1. CROSBY IRON-CONCENTRATION PLANT AT NASHWAUK

of the washing plants—those at the Harrison, Hawkins and Crosby mines—are similar in the general process employed and, with the exception of certain details of practice, the general method used at the Trout Lake concentrator is followed. La Rue mine follows a somewhat different process, which is discussed at length later in this article.

The washing plants at Nashwauk are of interest because they are attempting the concentration of ore on

*Grand Rapids, Minn.

a smaller scale than that at Coleraine. The Crosby is called a half-unit plant, while the Hawkins and Harrison concentrators are called one-unit plants and have a capacity of about one-fifth that of the Trout Lake mill.

A description of the Crosby plant will make clear the characteristics of the Hawkins and the Harrison. The ore is taken from the mine and dumped from a 20-ft. trestle into two bins, shown in Fig. 1, from which it is fed to a conveyor belt by two Stevens-Adamson apron feeders. This conveyor belt is 30 in. wide, 219 ft. long, slopes 20° and discharges into the mill at a height of 69 ft. above ground. The ore discharges, into the trommel from the conveyor, which has perforations 2 in. in diameter. The oversize discharges to the shipping bins, and the undersize passes into a log washer, shown in Fig. 2, which is 25 ft. long, 6 ft. wide and 3 ft. deep, and is of the Greenway-Hutch type. At the bottom of the log washer the ore meets a strong current of water under pressure, which prevents the materials from lying at the bottom. The paddles break up the ore, and the heavy flow of water carries part of the lighter material over the lower end of the machine, while the heavier ore particles are forced by the action of the paddles toward the upper end and discharge to the shipping bin.

The overflow from the lower end of the log washer is conducted into what are called "turbos." A turbo is constructed similar to a log washer, but is somewhat smaller in its dimensions. The one at the Crosby plant is 18 ft. long. The overflow from the turbos is fed to a series of Overstrom concentrating tables of Allis-Chalmers make, shown in Fig. 3. The tables make an iron product that flows to the shipping bins, while the lighter and sandy material is discharged to waste.

FIG. 2. LOG WASHER AND CHIP SCREEN

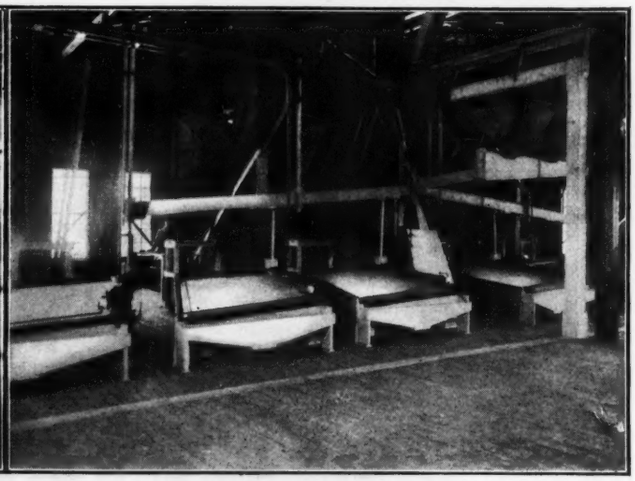


FIG. 3. OVERSTROM CONCENTRATING TABLES

Machinery Equipment of a Mill Unit

Such is the process in general. There are several variations of this in the three plants operating with this type of equipment. There is, for instance, a difference in size of the various plants. The Harrison and Hawkins plants, of one-unit capacity, comprise one trommel, two 25-ft. log washers, four turbos and a varying number of tables. A half-unit plant comprises only a trommel, one log washer, two turbos and a smaller number of tables. The Crosby plant is so constructed that additional machinery can be installed to make it of one-unit capacity, just as the Butler plant, which was built last year, was changed from one-half to one unit during the past winter.

At all the plants at Nashwauk the ore is conveyed by belts to the top of the building, while at the Coleraine plant it is dumped directly from the cars into the top of the structure. A difference in the iron-ore formation, of course, calls for variation in the equipment. At the Crosby plant, for instance, a picking belt is used, which is not found at the Harrison plant. This is 20 ft. in length and 30 in. wide. The rock and useless material is picked from the belt, and the ore to be crushed is sent to a 7x10-in. Blake crusher of Allis-Chalmers make.

A chip trommel with ¼-in. perforations is another feature of the Crosby plant, shown in Fig. 2, receiving the discharge from the log washer.

At the Butler plant the chunks of ore too large to pass through the grizzlies onto the apron feed to the inclined belt conveyor, were formerly crushed in a large gyratory crusher, but this was removed in the early part of the present season.

The number of concentrating tables is another feature at the Crosby plant. There are five single-deck Overstrom tables for the one-half unit. At the Hawkins plant, 18 double-deck Overstrom tables for use in the one unit were installed last season, and at the Harrison plant the present equipment includes 12 double-deck tables for the unit. The number of tables is of course regulated by the degree of concentration desired.

All the plants are of steel construction. The Crosby plant, which is typical in size of the others, is a steel structure with dimensions of 62x67 ft. and has an extreme height of 81 ft. The machinery is all of Allis-Chalmers manufacture.

The capacity of a one-unit washing plant is about 5,000 tons of concentrates per 24-hr. day. This is now the approximate production at the Hawkins plant, and it may be considered the standard for a mill of this size.

Wetherbee Concentrators at La Rue Mill

At La Rue plant of the M. A. Hanna interests the ore is washed by a method different from those used in the three other plants. La Rue plant has been so far largely an experimental one. The process involves the use of a log-washer and Wetherbee concentrators. The ore is dumped from the cars into bins and is fed onto a 24-in. belt con-

veyor with the apron feeder. Upon discharge at the top of the mill the ore is screened through a trommel of 5-ft. diameter with 1-in. perforations. Its undersize discharges to a log washer, whose overflow passes to a 6-ft. Wetherbee concentrator, whose overflow in turn passes to a 3-ft. Wetherbee. The feature of the process is the use of this type of machine in place of turbos and concentrating tables.

The Wetherbee concentrator is designed to simplify the iron concentration process and do the work now done by turbos and tables. The machine, as shown in Fig. 4, consists of a cylindrical drum carried on a vertical shaft within an outer casing. The shaft is driven from above. The drum compartment receives the ore to be washed and discharges it by centrifugal force through openings into the annular space between the drum and casing.

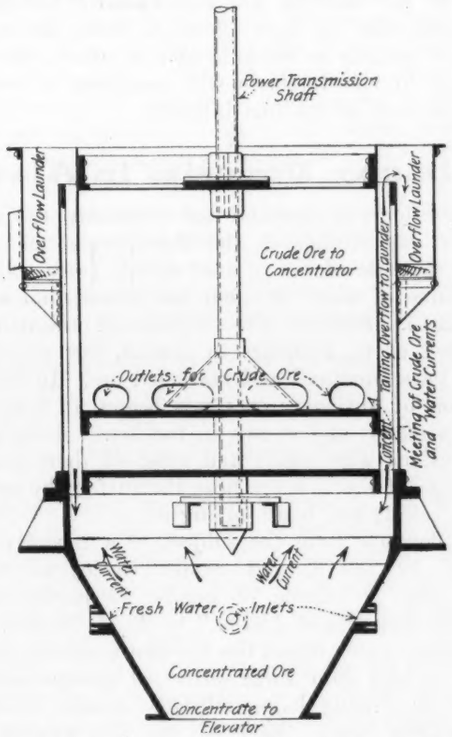


FIG. 4. WETHERBEE CONCENTRATOR

The casing has an overflow launder at the top and is bolted at the bottom to a water-tight compartment connected with the boot of an elevator. The required water enters at the base of the machine, rises through the annular space between the revolving drum and the casing, and discharges into the overflow launder at the top of the casing.

Centrifugal Force Reduces Water Consumption

The work of the machine is based on the following principle: If, during a second of time, a particle of ore settles 4 in., while a particle of quartz settles only 2 in., it is evident that in order to separate these two particles by means of an upward current of water, a current of somewhere between 2 and 4 in. per second would be required, or say 3 in. per second. Assuming that these same two particles are placed in the Wetherbee concentrator and the revolving drum given such a velocity that the quartz particle remains in suspension, traveling in a given horizontal plane, the heavier ore particle in the same length of time will settle, say 1 in. It is then evident that the slightest upward flow of water will wash out the particle of quartz and still allow the particle of ore to settle, and that the same results are secured by the use of this machine with an upward flow of, say, only $\frac{1}{16}$ in. per sec. as could be secured by upward current alone with a flow of 3 in. per sec., or in other words, with the use of $\frac{1}{48}$ of the amount of water. The fact that the whirling current can be controlled independently of the velocity of the upward rising current allows an exact and independent control over the material that goes into the overflow or into the concentrates, by changing either the speed of the drum or the amount of water used.

La Rue is the only concentrating plant of this type on the Mesabi Range, and its results with Wetherbee concentrators will be watched with interest.

The washing of iron ore means more than most people probably realize. It has only been through the employment of the methods described that the development on the western Mesabi has been permitted. The evolution of the concentrating process has allowed the development of iron-ore deposits that have brought millions to the owners, to the operators and to the public. Today every mine west of Keewatin has all or part of its ore treated in some such manner. Probably during this season no less than 40,000 tons of concentrate per day is being shipped, and there is no doubt that if other properties are opened up and become shippers, other plants will be constructed. How they will differ from those of Nashwauk will of course be a matter of speculation. One might say that there has been little or no difference, except in details developed in the concentrating process since the Trout Lake concentrator was built. The Wetherbee process is the only variation that involves anything entirely new.

Radium Production in Bohemia

In the mining of uranium ore in Bohemia, 25,720 lb. of uraninite prepared for smelting, having an average value of $471.50 per 100 lb., was produced in 1915, according to the United States Commerce Report. Of the different uranium compounds, there was produced in the Government mine in Joachimsthal 2,325 lb. of an average value of $252.50 per 100 lb.

The Government factory for radium compounds produced compounds containing 1.754 grams (27.07 grains) of radium elements having a total value of $209,364.50. The radium production in 1915 represented an increase of 0.879 gram (13.57 grains) as compared with the production in 1914, the value of which shows an increase of $100,000.

German Substitutes for Copper

War substitutes for the 6% by weight of copper, which on the average goes into the manufacture of a German locomotive, are reported, according to *Iron Age*, Aug. 10, 1916, to be in part as follows: The fireboxes and stays are now made of cast iron. All the smoke and steam tubes and the oiling cocks and thin pipes are of weldless drawn steel. For the rod bracings, axles, grease boxes and the bracing parts, the difficulty is believed to have been overcome by using cast iron and a special alloy called flange metal, which is a mixture of tin, lead and antimony. It is regarded as possibly dangerous to

use this metal unless the pins and axle journals are previously bushed with white metal. Cast iron is used for piston boxes, side-valve rods, frames and lubricators, lubricator covers and step bearings. Bronze covered with vulcanized rubber, which was the standard metal for the various handwheels, is being replaced by cast-iron wheels covered with ordinary string or jute fabric. German engineers are now experimenting with a new rolling process for preparing the flange metal referred to, having an equivalent of bronze, which will dispense with antimony.

American Institute of Mining Engineers in Arizona

The meeting of the American Institute of Mining Engineers, which convenes in Arizona on Monday, Sept. 18, promises to be a noteworthy one in the annals of the Institute. Geographically the selection of Arizona as a meeting place is particularly fortunate, since it is in the center of a highly modernized mining and metallurgical district that has abundant examples of the most recently developed methods both of mining and of metallurgy. Particularly will engineers be enabled to see and study the best applications of recent methods of fine-grinding of ores and also some of the best applications of the flotation process.

The leading metal-producing companies of all sections of the country will be represented by members of their staff, who will make the trip primarily for the purpose of acquiring valuable information. The country's record production of metals during the last year has greatly stimulated the interest in those general mining topics that will be discussed at the Institute's sessions. The great advance in copper production will promote interest in the huge porphyry copper mines of Arizona.

It is said that more than twenty corporations will be represented by Institute members, who may participate in the technical discussions. Among these are the Anaconda Copper Mining Co., the largest copper-producing corporation of this country; the American Smelting and Refining Co., the largest lead-producing company; the Ray Consolidated Copper Co., the Treadwell and Alaska-Juneau mines, the Miami Copper Co., and the New Jersey Zinc Co.

Many of the most prominent engineers of the profession will be present, among whom may be mentioned: Dr. L. D. Ricketts, president of the American Institute of Mining Engineers; B. B. Thayer, of the Anaconda Copper Mining Co.; William L. Saunders, Sidney J. Jennings, George D. Barron and Philip N. Moore, of St. Louis. A special train has been provided for the party from New York and vicinity and will become the traveling headquarters, moving from point to point in Arizona each day during the week of the convention.

A great many interesting papers have been prepared for discussion at the meeting. A total of about seventy are to be considered, most of which bear largely upon new methods of production and the mining outlook in various parts of the world. Some of the interesting papers that may be mentioned are: "Automatic Operation of Mine Hoists as Exemplified by the New Electric Hoists for the Inspiration Copper Co.," by H. Kenyon Burch and M. A. Whiting; "The Water Problem at the Old Dominion Mine," by P. G. Beckett; "Power Plant of the Burro Mountain Copper Co.," by Charles Legrand; "Geology of the Warren Mining District," by Y. Bonillas, J. B. Tenney and Leon Feuchere; "Flotation Concentration at Anaconda, Mont.," by Frederick Laist and Albert E. Wiggin; "History of the Flotation Process at Inspiration," by Rudolf Gahl; "The Advent of Flotation in the Clifton-Morenci District, Arizona," by David Cole; "Comparative Test of the Marathon, Chilian and Hardinge Mills," by F. G. Blickensderfer; "The Inspiration Plant, Concentrator and Other Surface Equipment," by H. Kenyon Burch. The first technical session, to be held on Sept. 19, will take up the subjects of "smelting" and "leaching."

All these papers are of exceptional interest to the mining profession at this time, and they are all good papers, splendidly written and highly informative. The visitors at the meeting are exceptionally fortunate in the program that has been offered to them, and to those who are so unlucky as not to be able to attend, the papers as printed by the Institute will constitute a record of great value and of extreme interest.

Antimony Deposits in Alaska

The considerable demand for antimony during the last year has stimulated the development of certain Alaskan deposits of ore of that metal, from which ore to the value of about $74,000 was mined and shipped during 1915. Stibnite, the sulphide of antimony, has been noted at 67 localities in Alaska, but only a few of these have produced and marketed ore. In 1915 the production of antimony ores was begun at four mines in the Fairbanks and at two in the Nome district. All the operations were small and most of them consisted of digging out the rich ore near the surface by opencuts and of breaking and hand-sorting it.

These deposits form the subject of a report recently published by the United States Geological Survey, Bulletin 649, a volume of nearly 70 pages, entitled "Antimony Deposits of Alaska," by A. H. Brooks.

According to this report the Alaskan antimony deposits may be divided into three principal groups—siliceous gold-bearing stibnite lodes, stibnite-cinnabar lodes, and stibnite-galena lodes. Each of the first two of these groups is further divided, according to structure, into fissure veins, shear vein deposits and stockworks. A free copy of this report may be obtained from the Director, Geological Survey, Washington, D. C.

Powers of Miners' Unions

By A. L. H. Street*

In denying the right of the Western Federation of Miners to compel a local miners' union to perform a contract to transfer its property to plaintiff the United States District Court for the district of Montana lately decided that a union organized under the laws of that state for the purpose of furthering the interests of its members was without authority under its charter to surrender its powers to the Federation, subordinating itself to the control of that association and agreeing to forfeit its property to the Federation in the event of secession or expulsion therefrom. (Moyer vs. Butte Miners' Union, 232 Federal Reporter, 788.)

*Attorney at law, 829 Security Building, Minneapolis, Minn.

Stoping Methods at Miami*

SYNOPSIS—The mining of an orebody of 2,300,000 tons estimated content, of which 95% was won, is described. Body developed by levels and sublevels. Shrinkage stoping was used, leaving 50-ft. pillars for support. Final stage consists in removing the pillars. Stoping starts at the lowest level and proceeds upward while pillar mining starts at the top sublevel and proceeds downward. Distribution of weight during operations is discussed.

The relatively hard character of the ground in the western section of the property of the Miami Copper Co., Miami, Ariz., made it advisable to use a wide shrinkage-stope and pillar system of mining. The system as finally evolved was applied to the mining of 2,300,000 tons of ore by the use of stopes and pillars each 50 ft. in width. Development, mining and extraction of this orebody has been continuously in progress since 1910, and the final stages of extraction are now reached. A complete survey of all phases of this system can therefore be made. Modification in working methods was obviously necessary, and the system to be described is believed to be typical of the best features.

Development by Levels, Sublevels and Drifts

The preliminary work had three main objects: The opening of a haulage level, the construction of a drawing-off level, and the driving of sublevels for use in stoping. In addition to these, some extra sublevel drifting was necessary to determine exactly the boundaries of the orebody, the general outline having been determined by churn drilling. This development was based on the requirements of stopes 50 ft. wide, with pillars 50 ft. wide between each stope. The length of these units varied from 200 to 500 ft.

The tramming, or haulage, level was 50 ft. below the floor of the stopes and parallel to the longer axis. These lines were also beneath the middle of the stopes and pillars. Each line therefore served one stope and one pillar, this arrangement making it possible to load along an entire stope without switching or uncoupling. This advantage is apparent principally during the process of stoping when rapid drawing of excess broken ore is desirable. Furthermore, the arrangement of the drawing-off level chutes at 25-ft. intervals, as shown by Figs. 1 and 2, makes this arrangement of the haulage level necessary for a minimum of development. The drawing chutes were all on one side of the drift, each chute terminating in the drawing-off level 25 ft. above the tramming level. With each chute having a capacity of 15 tons, a block of seven, therefore, held a little more than the normal trainload of 100 tons. All chutes were of standard design, of the flat-gate or guillotine pattern with hand-operated levers. Rocks greater than 10 in. in size were seldom delivered from them, and chute blasting was practically eliminated on this level. With cars of 3½ tons capacity, the loading rate was from 3 to 5 tons per minute.

*Paper to be read at Arizona meeting of A. I. M. E., September, 1916, by David B. Scott, mine efficiency engineer at Miami Copper Co.

In the timbering of the haulage level, 10x10-in. timber was used almost entirely, sets being spaced at 6-ft. 3-in. centers. The standard set which is in use at present requires a 9-ft. post and 8-ft. cap, the posts being hitched in the ground 7½ in. below the ball of rail. All drift-set posts are set at a batter of 1½ in. per ft.

A distinctive feature of this system was the drawing-off level, 25 ft. above the tramming level. This was used for handling all stope and pillar ore from raises which perforated the stope floors, and delivering this ore through grizzlies to the tramming chutes. The primary drawing raises, as shown in Fig. 3, branch from each side of the drift and deliver directly into the chutes. The secondary, or intermediate, raises used extensively in the pillars were midway between these chutes, and delivered to them by means of inclined slides.

The drawing-level drifts were driven parallel to the haulage drifts, with a fringe drift at each end to provide entry and ventilation. Stope drawing lines were directly under the center of the stopes, so that the raises were symmetrical. Pillar drawing lines were generally 5 ft. south of the long pillar axis for convenience in putting up vertical development raises through the pillars. This arrangement was later modified, so that symmetrical raises were also possible in the pillar lines.

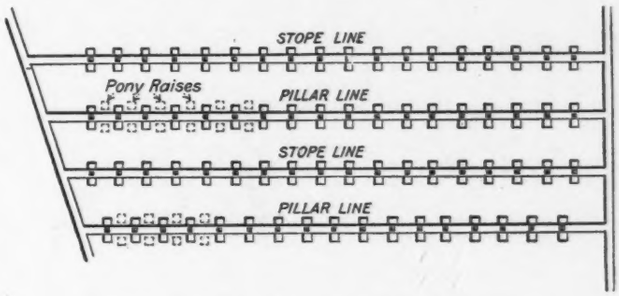


FIG. 1. PLAN OF DRAWING-OFF LEVEL

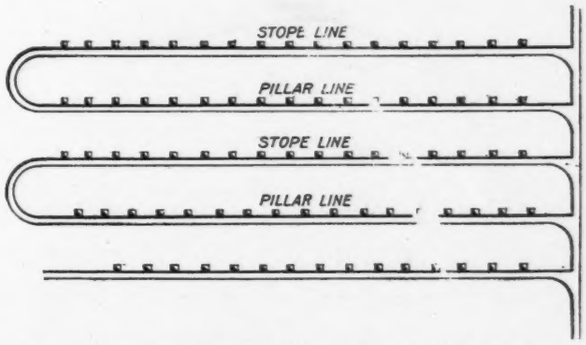


FIG. 2. PLAN OF TRAMMING LEVEL—SAME AREA AS FIG. 1

The pocket chutes into which the ore was drawn from the stope raises were all cribbed, 5 ft. square in the clear, 6x8-in. and 8x8-in. cribbing being used. Experience showed that the 8x8-in. size was the most economical over a long period. The life of this cribbing was variable on account of the quality of the ore, a representative group of chutes showing a cribbing life of 12,430 tons each.

To eliminate boulders in the tramming chutes, grizzlies were placed over the collar of these chutes on the drawing level. The grizzly opening was 18 in. square. It was found to be highly desirable to have these grizzlies placed several inches above the collar of the raise to permit easy working when ore hangs up on the grizzly. It was also found to be best practice to have the opening in the grizzly not less than 18 in. square directly below the lip of the chute, as this is the point where "hanging up" on the grizzly starts. The design of the drawing raises in the stopes from the drawing-off level to the stope floor differed slightly from those in the pillars.

From the floor of the drawing level, inclined raises on each side of the drift were run up to the edges of the stope, and then funneled. Vertical center raises

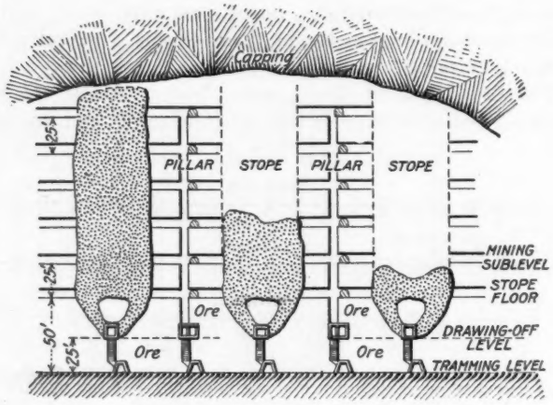


FIG. 3. CROSS-SECTION THROUGH STOPE PILLARS

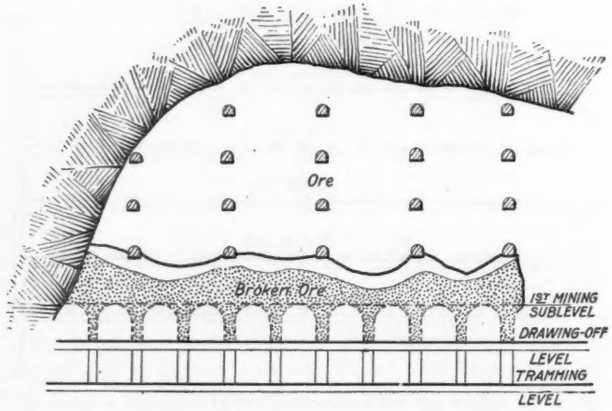


FIG. 4. SECTIONS OF STOPE DURING MINING

through the roof of the drift were originally employed, but their effectiveness is rather doubtful, and they are both difficult and awkward to draw. This arrangement gave sets of two raises in one plane along every 25 ft. of stope. Funneling of these raises to a top diameter of 20 ft. gave a practically continuous perforation of the floor of the stope. The raises were in general 6x6 ft. at the bottom. The back or hanging wall, constituting part of the roof pillar between the drawing level and the stope floor, had a tendency to collapse under weight, but this proved rather an advantage in providing a larger opening for the drawing of the stope ore. Timbering inside of these drawing raises for support of this brow was therefore unnecessary.

Later practice provided raises in the pillars of the same general type as those found in the stope, but their planes were not in a continuous line with the planes of the stope couples, but midway between them, as shown in Fig. 5. The earlier type of arrangement, with stope and pillar raises all in the same plane, was also extensively used and is shown in plan in Fig. 5, 1 and 2. This arrangement is probably not as effective in drawing, however, as the other.

An additional arrangement, and one largely used in the drawing of 500,000 tons of pillar ore, made use of intermediate raises. These were located 12½ ft. from the regular raises. To provide outlet for the ore, these were put up from "pony sets" in the roof of the drift, and delivered to slides which ran down into the regular 25-ft. pocket chutes. These intermediate raises provided double the ordinary number of openings into the floor of the pillar.

The timbering requirements of this level have shown that the drifts can be supported with 10x10 timbers spaced at 5-ft. centers, using 8-ft. posts and 7-ft. caps. This type of timbering remains nearly intact in some of the drawing lines after two years of service. (The

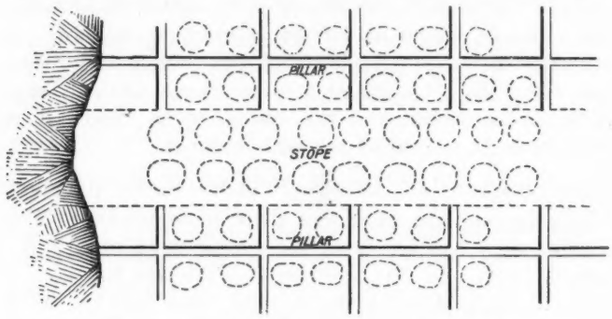


FIG. 5. PLAN OF SHRINKAGE STOPE

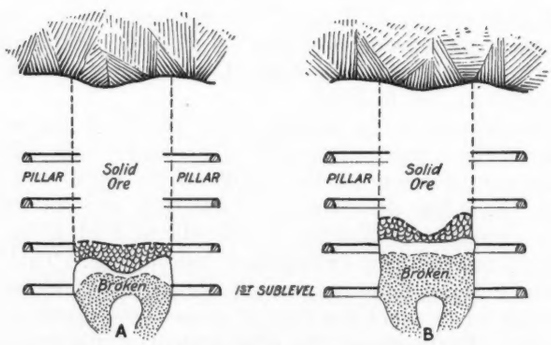


FIG. 6. CROSS-SECTIONS THROUGH STOPE

chute timber details of the type which gave satisfaction, under conditions of heavy weight and wear of drawing, are shown in Fig. 11.) This set is especially effective in keeping weight from the cribbing in the pocket chutes to the tramming level. Experience has shown that on this level a minimum amount of 2-in. lagging on drift sets should be used, and this should not be placed closer than 2 or 3 in. apart. "Pony-set" timbering for the intermediate chutes required the use of 12x12-in. posts in the sets. An inside height of 8 ft. in these sets was found to be more desirable both for drawing and for repair than a 6-ft. height.

The provision of means of entry and ventilation for the stopes governed the type of sublevel, or mining-level

development. The distance between levels was fixed at 25 ft., and this distance proved to be convenient especially in the later mining of the pillars. Obviously the arrangement of drifts and crosscuts underwent some revision in opening up new ground, and as the nature of the ground became understood, the following type of development seemed to be the best for the mining of wide stopes and pillars:

Along the axis of the pillars, drifts were run to the ore-limits. Crosscuts at 50-ft. intervals were driven each way across the pillars to the stope boundaries. Raises for handling development ore were provided at 50-ft. intervals along the drifts. Although in earlier development crosscuts were driven entirely across the stopes, connecting all of the pillar lines, they came to be regarded as unnecessary in the breaking of the stopes. If we assume therefore that no development is required in the stopes themselves, the combined tonnage of stope and pillar ore served by this development is 67 tons per foot of drift and crosscut, and 400 tons per foot of raise. Considerable secondary crosscutting and raising in addition to this, however, was necessary during the later pillar mining.

Mining in Shrinkage Stopes

The first operation was the funneling of the drawing raises. This was done at first by cutting out a chamber above the raise and drilling 8 and 10 ft. down-holes with water Leyner machines, all around the circumference of the raise. This proved unsatisfactory for the reasons that the holes did not break well, and that it was difficult to drill deep down-holes of nearly vertical pitch with this type of machine. The method used almost entirely was that of setting up in the raise and drilling up-holes with the same machine, in a ring around the raise. This successfully funneled the raise to a diameter of 15 to 20 ft. Continuation of this funneling produced a stope floor perforated with openings which practically touched on the rims across and along the whole stope. Setting up on the broken ore, the ground was squared along the sides of the stope and any stubs between funnels blasted out. The floor of the stope was thus opened out with a back 50 ft. wide and a length of 200 to 500 ft.

Using the entries on the first mining sublevel, drilling was started along each side of the stope. Steel as long as could be swung in the space was used, and holes from 10 to 15 ft. in depth were drilled upward and outward toward the center of the stope. The results of these preliminary rounds, as shown in Fig. 6, were twofold: About half of the distance to the next sublevel entries was broken along the wall of the stope, and a long belly or rib was left in the center of the stope. The principle of caving was therefore made use of to some extent in the breaking of this central rib, which was drilled in the succeeding round. After the first cut, the back was maintained on a flat incline until connection was made with the pillar crosscuts on the level above. Originally some use was made of crosscuts across the stope on the level immediately above the stoping operations, in order to drill down-holes into the back and thus assist the caving of the central portion of the stope. This was not satisfactory, principally because of the difficulty in getting deep holes and in getting a wide enough reach across the back. The results did not justify the extra development expense entailed.

After each drilling shift the excess of broken ore was drawn so as to allow from 6 to 8 ft. of open space between the back and the broken ore. Large blocks of caved ore were "bulldozed" in the stope, when possible, to prevent later plugging of the drawing raises. When connection was made with each successive entry crosscut on the level above, the back and sides were squared up and the stoping continued upward in the same manner. The stopes were carried to a maximum height of 125 ft., it

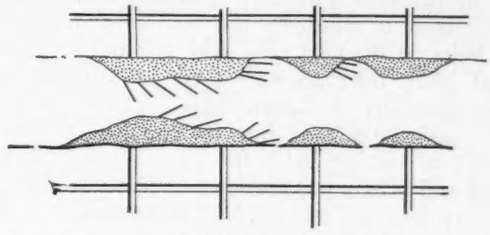


FIG. 7. PLAN OF STOPE, SHOWING DRILLING

being necessary in most cases to break right through to the capping. In a typical stope of hard ore, the expansion in volume due to breaking, required the drawing of 39% of the ore in the stope, the latter being full to the back at completion.

Drilling was done with steel from 10 to 16 ft. in length. The maximum footage of holes drilled per shift was 110 ft., and the average from 60 to 80 ft. according to the number of set-ups required.

Pillar Mining Started at Top Sublevel

The process of breaking the pillars was practically the reverse of stope breaking. Mining was started at the edge of the ore on the top sublevel and carried downward level by level; in each case the 25-ft. roof pillar was broken through to the broken ore above. This retreating method was desirable for two reasons—it provided a safe exit from working places and it insured an even settling of the capping. As soon as the process was started, even in the hardest ground, speed of working was essential because the pillar took weight as soon

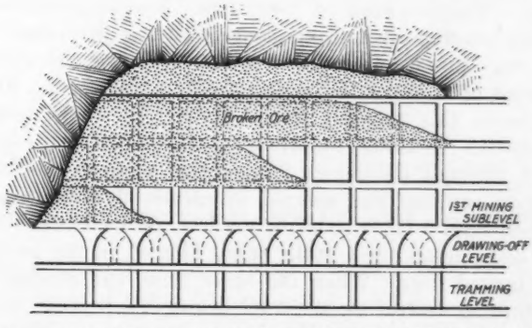


FIG. 8. LONGITUDINAL SECTION THROUGH PILLARS

as the capping became dislodged. The mining was done successively on three or four levels at a time at different points of attack, the work on each level being 100 ft. nearer completion than the work on the one below it, as shown in Fig. 8.

Preliminary crosscutting halfway between the original crosscuts was generally required to give better drilling faces, especially in the harder pillars. After this crosscutting had been well advanced on the top level, drilling was started at the end of the pillar and across its whole

width. Following the first rounds, sufficient broken ore was mucked to give entry on the sloping ore, and machines were set up on the broken ore and long holes drilled in the back. On the top level the ore was not broken nearer than 10 ft. of the capping. Drilling followed strict procedure in retreating from the edges of the pillar toward the central drift, and in the retreat along the central drift as the sides were broken. The roof was carried at a slope of about 45°. All holes were drilled in the same direction—pointing away from the line of retreat to eliminate the chance of drilling into missed holes on the next cut. The original development raises at 50-ft. intervals were used for mucking excess ore, and generally an intermediate series of raises was put up, making the raise interval 25 ft. The final development to tonnage ratio for the completed breaking of stopes and pillars was therefore reduced by this pillar work to 45 tons per foot of drift development, and 200 tons per foot of raise development.

The first round of holes drilled from the level floor broke to about 12 ft. above the sublevel, and the second round on which long steel could be used increased this height above the sublevel to 20 ft. It was common practice to drill through to the broken ore above, but the

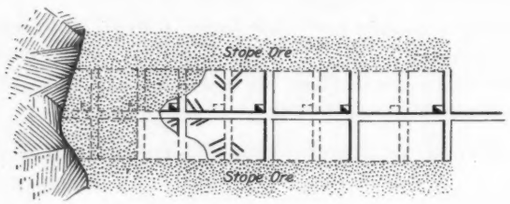


FIG. 9. PLAN OF PILLAR

remaining arch, 5 ft. or so thick, usually caved when the back was arched the whole 50 ft. of pillar width. At the start of this work the experiment was tried of drilling down holes in the floor of the sublevel to a vertical depth of 5 ft., to assist this subsequent caving through from the level below. It was necessary to case the collars of these holes with 3-in. pipe to prevent fitchering. The breaking of these holes was unsatisfactory, so this practice of drilling floor holes was discarded.

A very important detail of pillar work was the covering-over of raises as the work retreated past them. Failure to do this properly would defeat the whole system of careful breaking in, allowing the capping to pipe down through the raises. Protection against this running of capping was secured by means of stulls placed in each raise 5 ft. or so below the level on which breaking was being done, these stulls being hitched in the ground and lagged over. When the same raise was reached in the mining retreat on the level below, the process would be repeated and the stull covering above would then be blasted out, allowing the broken ore to fall to the newer and lower raise covering.

Mining on the last, or sill, floor of the pillars was subject to modifications imposed by the "pony-set" raises, which split the distance between the regular 25-ft. raises on each side of the pillar. These raises were funneled in retreat from the end of the pillar, along with the regular raises. This funneling was not carried more than 25 ft. ahead of the pillar breaking, because it virtually undercut the entire width of the pillar. Machine set-ups across the raises for the purpose of drilling the back were made on 10x10-in. stringers which extended across the funnel. This was done to insure against a sudden settling of broken ore in the raise, as occurred occasionally, with consequent danger to the machinemen.

Distribution of Weight During Stope Drawing

Systematic drawing of the broken ore was started when about 70% of all stope and pillar mining had been completed. No drawing was permitted within 100 ft. of any mining operations. Drawing of one stope next to a pillar which was in proces of being broken was tried as an experiment, and it caused crushing and swaying of the pillar even in the hardest ground.

The question of weight on the drawing-off level during the drawing period is one of the interesting features of this system. At the outset there was considerable weight in certain definite portions of the drawing-off

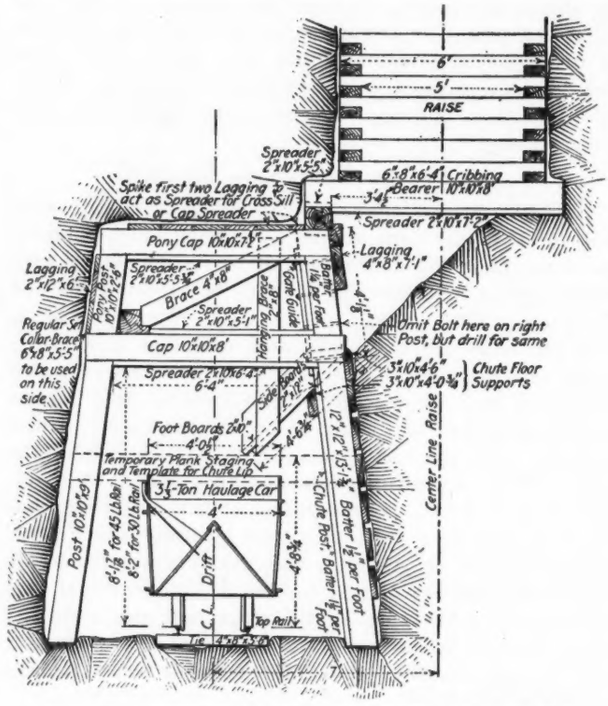


FIG. 10. SECTION THROUGH DRIFT AND RAISE

level, and no weight whatever in other sections. This variation in different sections was due undoubtedly to a combination of the following factors: First, the height of capping above the ore in the northern section averaged 340 ft. with a thickness of broken ore of 125 ft. below it. This gave a total height of ground of 465 ft. in a mobile condition. The southern drawing section had an average capping thickness of 250 ft. and a volume of broken ore a litle over 100 ft. thick, with a total thickness of movable ground of 350 ft. The crushing in the northern section was such as to require complete retimbering in some of the stope lines. In the southern section, the weight was almost negligible; only about 20% of the lineal footage of drawing drifts in this section became heavy enough to require repair for operation. Second, in a small section where complete breaking of the pillars from top to bottom was impossible, there were some blocks of unbroken pillar above the drawing level. The sections of drawing-off drifts below these unbroken areas were always heavy, probably on account of unequal

distribution of weight or the concentration of the weight on a few points. Third, when drawing had become developed on a large scale over a considerable area, the weight did not show any increase, but on the other hand it showed a decided tendency to slack off. Upon the completion of drawing in these sections there was little evidence of weight and the drifts remained open. It is likely that the broken mass of capping and ore reached a state of equilibrium, and that the weight became very widely and evenly distributed. It is interesting to note that in one large section where all conditions during mining were satisfactory and the pillar breaking most complete, about 70% of the timber put in three years ago on the drawing-off level still stands.

It is apparent that weight was thrown almost entirely on the drawing drifts and not on the pillars between these drifts, as evidenced by the presence of untimbered crosscuts through these pillars. That the drawing-off level took all the weight so that the tramming level was left intact is shown by the present condition of the latter. Sections of the tramming level beneath badly crushed drawing-level drifts do not even require lagging in the roof, and 8x8-in. drift-set timbers that have been in place nearly five years show no weight. This constitutes one of the most pronounced advantages of the drawing-off level.

The repair cost on the drawing-off level did not exceed 10c. per ton of ore drawn on any one stope or pillar line and went considerably below this cost on the tonnage served by the entire drawing-off level. Repair work was greatly facilitated by the presence of chutes every 25 ft. along the drifts.

Drawing Operations to Prevent Packing

Control of drawing was essential to procure an even lowering of the capping, and to permit a retreat from the western to the eastern limits of the drawing section. This required the pulling down of the capping on a more or less inclined plane which dipped possibly 15° to the western or completed portion. The drawing of a series of chutes in a plane at right angles to the direction of retreat, or across the stopes and pillars, instead of along one whole stope, was the most satisfactory method in getting the ore to run readily.

When drawing was started, there were some difficulties in getting the ore to run steadily. The nature of the ore and the length of time that elapsed between stoping and drawing, caused the chutes in some areas to pack very tightly. Some idea of the compact nature of broken ore under pressure can be gained from the fact that occasional crosscuts were driven from pillars into shrinkage stope ore, and that no timbering was required for some of these drifts in broken ore. A method that resulted satisfactorily in starting these chutes was the use of small "pony-set" raises put up in the back of the drawing-off level drift midway between the drawing raises. This involved running an inclined raise for 15 ft. on each side of the drift up to the broken stope ore. When a hole was drilled through into broken ground, the raise was funneled immediately, and blasting of this funneling round loosened the stope ore and usually the hung-up ore in the adjacent drawing raises. A series of these "pony-set" raises sufficed to make the ore run readily in the regular raises. This method had the disadvantage that the "pony-sets" took weight and were expensive. The second method, which involved no extra raises and which proved the more satisfactory, employed a system of breaking the arch of hung-up ore. Entry to the back of packed ore was made through the raises, and heavy stulling was done against the hung-up ore. Small drifts were then started in the foot wall of the raise and run parallel with the long axis of the stope and at a height of about 15 ft. above the drawing level. These drifts were driven in solid pillar ground and connected up a series of hung-up raises. Starting at the end of the drift, the ground was drilled vertically and horizontally across the stope. When these holes were blasted the legs between the regular raises were knocked out and an arch of broken ore left. Arches 40 ft. across and 30 to 50 ft. wide were not uncommon in this work and these arches invariably collapsed, bringing down the stope ore. In this work the hung-up ore would not cave, even if the next raise 25 ft. away was

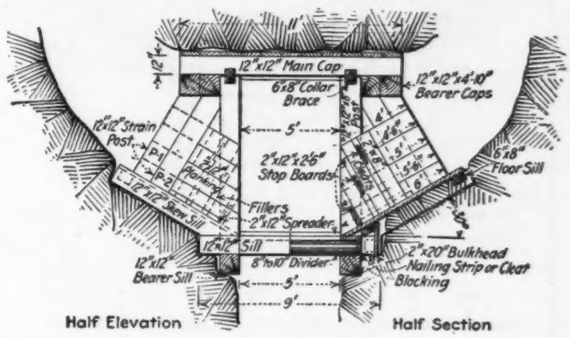


FIG. 11. DRAWING-OFF LEVEL CHUTE SET

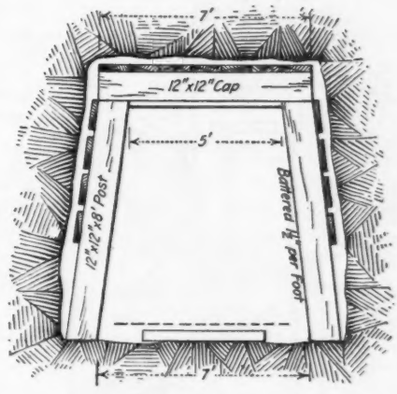


FIG. 12. DRIFT SET FOR DRAWING-OFF LEVEL

running regularly, so that there was little danger in this work underneath the broken ore, and no accident ever occurred.

Choking of chutes was caused occasionally by packing of ore in the bottom of the inclines. It was also necessary to blast out part of the brow of the raise over the chute to prevent plugging with boulders. It was desirable to eliminate blasting by chutemen, and a separate squad of blasters, who handled all of the explosives required in chute drawing, was part of the organization.

Over a period of one year with a drawn tonnage of slightly over 400,000 tons, the average rate of drawing per shift was 118 tons per man. The monthly range ran from 94 to 142 tons per man. These figures are based upon all labor directly employed in the drawing, including chute checkers. Under very favorable condi-

tions the tonnage per man has exceeded 200 tons for several shifts. The largest individual output ever reached on one shift was 440 tons by one chuteman. The cost of drawing this ore into the tramming chutes amounted to 3.7c. per ton over a year's period, for direct expense of labor and explosives. Where special methods were required in the case of hung-up ore, the cost for short periods went as high as 15c. per ton.

Figures on recovery of ore which involve a computed tonnage on one hand and a known tonnage on the other, must be approached with some caution, yet the results of drawing, on a total output of 1,700,000 tons in one

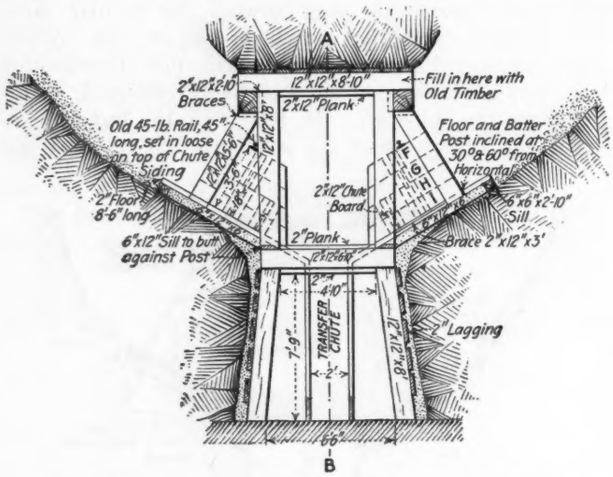


FIG. 13. ELEVATIONS OF PILLAR PONY-SET

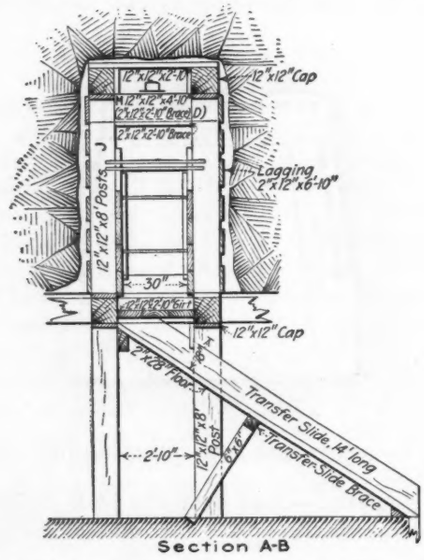


FIG. 14. SECTION ON A-B OF FIG. 13

section of the work may be of interest. This area showed an estimated recovery of approximately 95% of the original tonnage. Individual data were kept on each stope and pillar, and although the drawing from these is undoubtedly interchanged, the figures favored the stopes over the pillars by about 10%.

The harder ore was drawn more easily and with greater tonnage than the softer areas, because of the greater amount of packing under pressure in the latter case. In any case the compression of broken ore is an important factor, as it increases the tendency of the drawing chutes to ravel vertically toward the capping without drawing laterally. The broken ore even under moderate pressure tended to stand nearly vertically around the rim of a drawing chute. The angle of repose, if it can be so called in this condition, will be found to be between 80 and 90° in this class of ore. In a small number of chutes where the ore was greatly packed, the ore drawn corresponded in volume to a cylinder with a diameter of 14 ft. and a height equal to the height of ore to the capping.

It is apparent from this that a large number of drawing raises per unit of area rather than a large area in the funnel mouth of the raise itself is desirable for recovering the largest percentage of the ore.

Secondary Recovery of Ore

It became obvious at the conclusion of drawing that a certain amount of clean broken ore remained in the stopes and pillars. This remainder probably stood in the shape of a wedge directly over the drawing drifts and also along the boundaries of the old stopes and pillars. To recover the ore above the drawing drifts, the backs of the latter were shot down through to the floor of the stope. This work was done in retreat, and the ore mucked and drawn on the incline into the tramming chutes. This work cost from 15 to 25c. per ton, and the output per man averaged 40 tons. Results obtained from these operations confirmed the view that the clean ore stood in a series of wedges or cones, which had an apparent base of 20 ft. and a height of 50 ft.

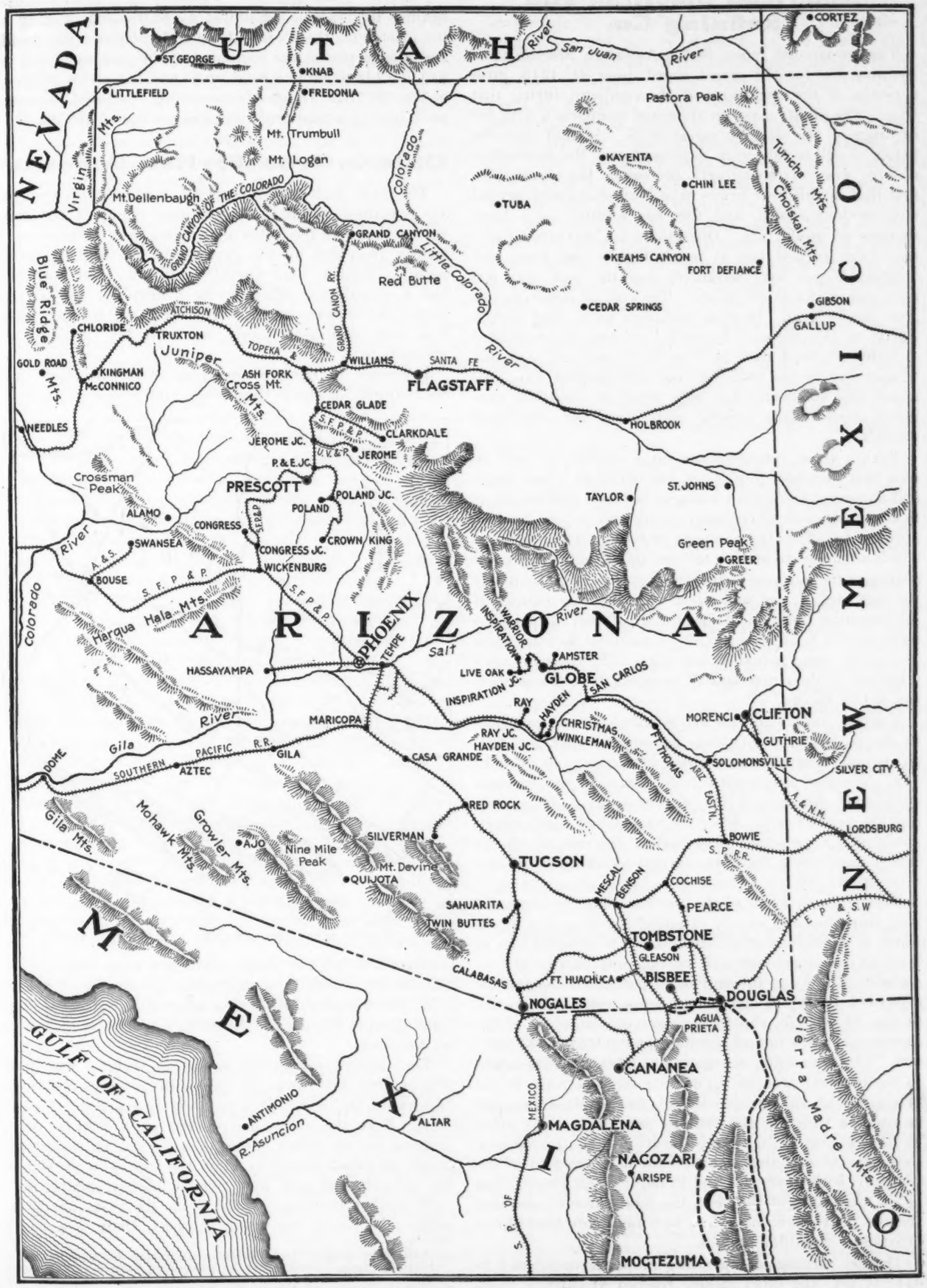
To recover the ore standing where the old stopes and pillars joined, a series of intermediate drifts midway between the original drawing lines was driven. These drifts were at the same elevation as the drawing-off level. Dumping chutes and supply raises were provided from crosscuts on the tramming level at 200-ft. intervals. The drifts were supported with 12x12-in. timbers set at a distance of 4 ft. 2 in. center to center, and chutes were placed in each set staggered along the drift. The back was broken on top of the lagging, and a small shrinkage stope about 20 ft. wide carried up until loose ground was encountered, or until caving occurred. The ore drawn from the chutes was trammed in 1½-ton cars to the main tramming raises, the maximum tram being 100 ft. This work, which is now in operation, marks the completing stage of mining hard ore by the wide stope and pillar system.

Duty to Safeguard Shafts

By A. L. H. Street*

A mine operator may be found to have been negligent in failing to secure removal of ice from around the top of a shaft, creating liability for injury to an employee caused by the ice falling on him while he was descending the shaft in the performance of his duties, when the only reason given for the nonremoval is that the work would have delayed other operations. But in reaching this conclusion, Springfield, Mo., Court of Appeals holds that the mine owner could not be held liable unless the dangerous condition was actually known or had existed so long before the accident that knowledge thereof fairly could be presumed. (Shimmin vs. C. & S. Mining Co., 187 Southwestern Reporter, 76.)

*Attorney at law, 829 Security Building, Minneapolis, Minn.



THE MINING CAMPS OF ARIZONA, SCENE OF THIS YEAR'S ANNUAL MEETING OF THE A. I. M. E.

American Smelting and Refining Co.

The semiannual report of the American Smelting and Refining Co. for the period ended June 30, 1916, gives a review of the operations of the company during that time. The profits make an abnormal comparison with the earnings of the same period in 1915. At that time the prices of all metals were depressed and the production of ores was correspondingly decreased, but during the first half of this year prices have been stimulated beyond any previous record, and this has resulted in a large increase of production. Operations, on the other hand, have been carried out at much higher cost than ever before. Wages have advanced, and the 8-hr. day has been introduced at all points. The cost of materials has gone up 50% and in some instances more than 100%. Partly on this account the profits per ton of ore smelted or bullion refined have been seriously reduced, and this is also due to the fact that the toll received from the mines and smelteries has been fixed in long-time contracts, made when present costs were not considered possible.

Taking these considerations into account, it will be seen that increased profits are due partly to a very large and abnormal increase in business, but to a greater extent to the production of company mines and to new lines of business in which the company has interested itself and which are hoped to become increasingly profitable. A few years ago the business of the company was almost entirely the smelting of lead and silver ores and the refining of the resulting bullion. This portion of the business has been far less profitable per ton of material handled than during the same period of last year. The company calls attention to the entire lack of earnings from the properties in Old Mexico.

The net income for the six months' period applicable to the payment of dividends amounted to $11,145,694, an increase over the same period of last year of $6,125,712. The last two quarterly dividends on the common stock were declared at the regular rate of 4% yearly and 2% yearly extra. After the payment of regular dividends on the preferred stock and at the rate of 6% on the common stock, there was carried to the credit of surplus, $6,642,960.

During the first half of the year the company purchased new properties and largely extended the capacities of old works at an expense of $3,623,786. It is expected that at least an equal amount will be laid out during the remainder of the year for similar purposes. Of the amount expended, there was charged to depreciation and ore depletion $1,019,489, and to the reserve created out of the earnings of 1915 for enlargement and extension, $1,999,590. The remainder, amounting to $604,706, was added to the property account. The very large increase in the production of all character of ores has required an equal increase in smelting and refining capacities. The proof of the successful accomplishment of this increase is shown by the fact that although the daily product of the company, both in amount and value, is much greater than at the beginning of the year, the total value of ores and furnace products on hand has decreased more than three-quarters of a million dollars.

The net earnings of operating properties amounted to $11,767,384, and other income reached $1,461,675, making a total gross income of $13,229,059. Total charges against this income amounted to $2,083,365, leaving a net income for the six months of $11,145,694. The profit and loss surplus at the beginning of the year amounted to $19,560,438, making a total profit and loss, gross surplus, of $30,706,132. Dividends amounting to $4,502,734 were paid, leaving a total profit and loss surplus of $26,203,398.

Ontario Iron-Pyrites Deposits*

The fact that the iron-pyrites resources of Ontario are contained within a considerable extent of territory will be shown in the following article; their value is sufficiently indicated by the exports of the last 15 years, totaling 538,755 tons worth $1,438,122. The war has had a stimulating effect on the demand of the United States for Ontario pyrite, and during the coming years this will doubtless result in a steady increase of production.

Reference to the accompanying map will show that the majority of the pyrites mines and prospects are concentrated within two main productive areas—the first a narrow belt extending about 8 miles southwest of Brockville, the second a broad area some 20 miles square extending from the town of Sulphide on the east to Madoc on the west.

OUTLINE MAP OF ONTARIO PYRITE DEPOSITS

The earliest mining for pyrites in Ontario was done within this first area on the Billings property, near Brockville, in 1868. This property is marked 1 on the map. Here the main openpit was sunk 250 ft. deep, gouging out the richer oreshoots and doing no timbering. While operation ceased in 1880, the men who worked in the old pits said they were not completely exhausted.

The other openings, 2 and 3 on the map, are prospects. At No. 2, the Sloan prospect, there is a width

*Abstract from "Iron Pyrites Deposits in Southeastern Ontario, Canada," a paper to be presented before the Arizona meeting of the A. I. M. E. by P. E. Hopkins, assistant geologist, Bureau of Mines, Toronto, Ont.

of 3 ft. of solid pyrites on the foot wall. Eighty tons of ore assaying 40% sulphur has been shipped from here to Buffalo and Capleton.

Steady output of the pyrite mines of the province began in 1898 with the opening of the Bannockburn mine, marked 6 on the map, and mines of Hastings County have been continuous producers ever since. Today the two main working mines are that of the Canadian Sulphur Ore Co. and the Hungerford of the Nichols Chemical Co., marked on the map Nos. 12 and 7 respectively.

At the Bannockburn mine, opened as an iron mine in 1898, the pyrites was encountered in two lenses at a depth of 8 to 15 ft. below a gossan of limonite. The south lens was mined for a length of 160 ft. and to a width of from 8 to 15 ft. and to a depth of 275 ft. During six years of operation about 580 tons of pyrite per month was shipped to the General Chemical Co. at Buffalo. The quality of ore did not decline with depth, but owing to the hazards of openpit mining operations were abandoned in 1906.

Hungerford Mine of Nichols Chemical Co.

The Hungerford mine, No. 7 on the map, though opened as a gold mine 40 years ago, was not operated continuously as a pyrite property till August, 1905, when the Nichols Chemical Co. established its title to it. In 1907 this company erected an acid works at Sulphide for the treatment of its own ores and also of other ores bought from the mines of the neighborhood.

The pyrite occurs in three parallel deposits dipping 60° to the south. The north deposit, upon which most of the work has been done, varies in width from 6 to 22 ft. It has been exploited to a length of 620 ft. and to a depth of 575 ft., and the ore still continues. The length as indicated on the surface is about 500 ft. There are now two shafts on the property, and about 3,500 ft. of drifting has been done on the orebodies on the six levels.

The ore is coarsely granular and makes a large percentage of fines. The main impurity is calcite, although there is also some quartz present. A small quantity of pyrrhotite occasionally occurs, mainly in the north lode next the foot wall. The average percentage of run of mine ore is about 35%, the fines being much higher.

The acid works have been successfully operated since their completion in July, 1907, and machinery has been installed at various times to increase the capacity and to make new acids. At present sulphuric, hydrochloric, nitric and mixed acids are made by the contact process and shipped in the company's tank cars to various parts of Ontario and Quebec. Electric power supplied by the Seymour Power and Electric Co. is used throughout the mine and acid works.

Canadian Sulphur Ore Co.'s Mine

The Canadian Sulphur Ore Co.'s pyrites mine, No. 12, was discovered in 1906 by Stephen Wellington while prospecting for iron. Under the gossan, merchantable iron pyrites was discovered, from which a carload of iron pyrites was shipped in 1908. Later the Canadian Pyrites Syndicate bought the property, installed a small plant and shipped a few hundred tons of pyrite. In the spring of 1910 the property was handed over to the present company, which began shipping ore three months later and has continued to the present. The mine is equipped to produce 100 tons of iron pyrites per day, yielding 40% of sulphur. Since Dec. 11, 1912, it has been run by electricity supplied by the Seymour Power Co. A branch line 2½ mi. in length from the Bay of Quinte Ry. near Queensboro to the mine was completed in 1913. The ore is shipped to the Nichols Chemical Co.'s acid plant at Sulphide, 11 mi. southeast, and to the chemical companies at Hamilton and Detroit.

The pyrite is mined by underground and openpit methods. The development work consists of three shafts and two opencuts, with some diamond-drill borings. The work in late years has been confined to shaft No. 3 and the two openpits. The vertical shaft No. 3 is 250 ft. deep with about 800 ft. of drifting on the 60-, 120- and 200-ft. levels. The pyrite deposits are marked by gossan outcrops from 2 to 30 ft. in depth. Beneath are the pyrite deposits, which occur as lenses in contact with rusty schist to the south and white quartzite to the north (both Grenville in age) near an irregular post-Hastings intrusion of gray felsite. The strike of the deposits is slightly north of east, while the dip is almost vertical, inclining slightly to the south. Lenses vary in width up to 25 ft., but horses of country rock are frequently inclosed in the pyrites.

The ore is high-grade, requiring very little cobbing if any. Ores have been shipped running 40 to 48% sulphur. The deposits are free from impurities such as arsenic, zinc, lead, copper and calcium. The pyrite burns satisfactorily and is in good demand by sulphuric-acid makers.

A promising prospect is the Hungerford Western Extension, No. 9 on the map. This was fairly well prospected in 1906 by means of surface trenches at regular intervals along the strike of the fahlband. The western lens had been exploited by surface trenches to a length of 500 ft., exhibiting, near the line between the lots, a width varying from 16 to 18 ft. of ore, which will grade from 42 to 44% sulphur. The only impurity consists of small included lenses of calcite. The eastern lenses are presumably continuations of the Hungerford mine orebodies. A gossan 40 ft. wide occurs on the south end of the property, but not enough work has been done to determine the extent of the deposit.

Among a number of other promising prospects may be mentioned the Ontario Sulphur Mines, Ltd., No. 9; the Queensboro, No. 11; and the Canada, No. 8.

Shattuck Arizona Copper Co.

The production of the Shattuck Arizona Copper Co. for August amounted to 1,699,575 lb. of copper, 253,143 lb. of lead, 30,542 oz. of silver and 508.71 oz. of gold. For eight months of 1916 the total production was 11,976,584 lb. of copper, 2,101,080 lb. of lead, 213,112 oz. of silver and 3,408.52 oz. of gold.

Arizona Copper Co. reports for the half-year ended Mar. 31, 1916, that the copper production was 2,957 tons, all produced in February and March. Of this 964 tons was disposed of as bessemer, and 1,993 tons was refined electrolytically. Net working profit was £158,613, from which must be deducted £29,418 for general expenses and £70,906 for interest and sinking fund, and to which must be added £7,980 from holdings in other companies, leaving a net balance for dividends of £66,268.

No. 4 Concentrator of Clifton was started the middle of April, but the flotation plant is not yet complete nor is all of the reconstruction finished. The oil-flotation plant at No. 6 concentrator in Morenci has likewise started operating, but is not yet complete.

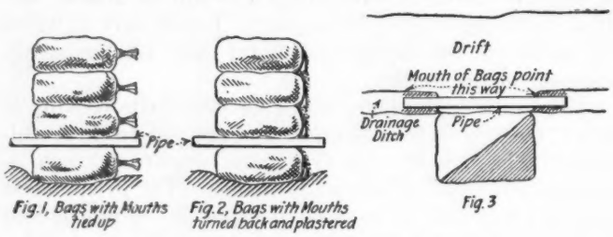
Details of Practical Mining

Underground Dams and Bulkheads

By Albert E. Hall* and George McFeely

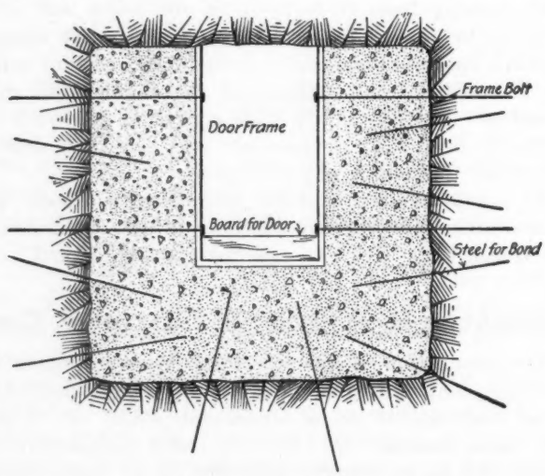
In some mines the amount of water is practically negligible, while in others its removal is a serious problem. Most mining men are familiar with the various forms of pumps and drainage systems in use, but possibly the use of underground dams is new to some.

One of the cheapest and most easily constructed dams is that made of clay, which is highly efficient within its



A DAM AND BULKHEAD OF BAGS

limits. There are many ways in which a clay dam can be constructed. A good one can be made from cement bags filled with clay. In this method of construction, the bags can be filled on the surface, and can be easily taken to the point desired in the mine. This is often



A CONCRETE BULKHEAD

advisable in restricted workings. At the point where the dam is to be constructed, all loose material must be removed. Clay is then rubbed in well on the rock surface, and the first row of bags is laid on this foundation. The bags are laid with their mouths on the water side of the dam, and the spaces between them are filled in with clay and the usual drain pipe is put in place. On this another layer of bags is laid and the spaces again filled with clay. This is continued until a wall is finally built. When it has been made high enough, the mouths of the bags are opened and plastered back against the face of the dam. If one wall of bags is not sufficient to withstand the pressure, another can be placed behind it or the wall curved to present a convex surface to the pressure. Since the bags are of small dimensions, the flexibility of this method is great.

Water may be carried past a raise by the use of this same method. This is done by laying a pipe over the raise and using bags filled with clay to fill in around its ends. Place the bags as shown in Fig. 3, and open the mouths and plaster them back after all are in place. If the opening is too small for bags, the clay can be put in without them in any amounts advisable.

If it is impossible to construct a sump of sufficient capacity, the lower levels may be used to hold the water if a suitable bulkhead has been constructed. These bulkheads are made of cement or concrete. A low place near the shaft is prepared, and then holes are drilled into the walls, roof and floor of the opening and reinforcing rods placed in them to act as a bond between the walls and the concrete. A doorway is left in the bulkhead, which is usually held in place by long bolts running into the walls. A batten door, calked with clay and fastened to the frame with iron straps, completes this bulkhead.

*Superintendent, Sable River Copper Co., Massey, Ont.

Method of Tunnel Ventilating

In the Wilson Avenue water tunnel, Chicago, which is 45,000 ft. in length, great care was exercised in the design and installation of the ventilating system, says H. W. Clausen in the *Journal* of the Western Society of Engineers for May, 1916, and a quantity of air much in excess of any heretofore used in similar work was provided. The standard equipment consisted of one General Electric centrifugal air compressor of a capacity of 5,000 cu.ft. of air per min. for each drift, at a pressure of 1.5 lb., where the length of the drift did not exceed 6,000 ft. Where the drifts were longer, two compressors were used in series, giving a capacity of 5,000 cu.ft. at 3 lb. pressure. These compressors were driven by 50-hp. motors operating at 3,600 r.p.m. and directly connected to the centrifugal impeller. Gage boards, upon which were mounted indicating and recording instruments, were provided so that an absolute check was maintained upon their operation. These compressors were supplied by William A. Pope at a price of $1,398 each.

Steel asphalt-coated pipe 18 in. in diameter delivered air to the face. This pipe was made of 14-gage steel in 20-ft. lengths, with ends flanged back at right angles to the axis of the pipe and provided with loose malleable-iron flanges. A soft-rubber gasket was inserted between two lengths, and the joint was then tightened up. The unusual point of this pipe was its light weight—two men easily lifting a 20-ft. length—and its strength. The pressure on a 20-ft. length when fans are exhausting is about 20 tons. The end of the pipe was maintained about 100 ft. from the bench.

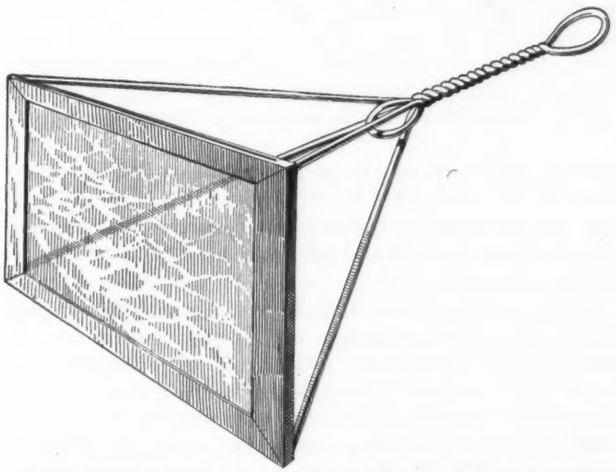
The pipe was suspended along the side of the tunnel over the drainage ditch. The system was operated equally well to blow in or exhaust air from the tunnel. After a blast the system was reversed and the powder smoke removed from the tunnel. This reversal was accomplished by a bypass with the necessary valves, the compressor always blowing in one direction.

A New Bob-Line Reflector

A short time ago there was published a description and sketch of a reflector for facilitating transit sights in mines. This is merely an extension or amplification of the old practice of tearing a leaf from a notebook and pouring oil on it to increase its transparency. This practice was however often hard on the notebook, says *Coal Age,* Sept. 9, 1916.

The objection to the device described is that the tracing cloth must be given a circular cut, and while the exact method of fastening is not shown, whatever mode is used it will take time. And when the sights are to be given from "cartwheels" or other points in the roof not marked by a spad from which the plumb bob line may be hung, three hands are required: One for the device, one for the bob line, and one for the lamp. As the ordinary run of mine-survey help is provided with but two, its operation would be difficult.

The accompanying illustration shows a device that can easily be made in the blacksmith or carpenter shop.



REFLECTOR FOR USE IN UNDERGROUND SURVEYING

A tin frame is made to hold a half sheet of ordinary letter head or extension sheet paper, the upper edge of the frame being left open for its insertion. Four wire standards are soldered or riveted to the frame. These are carried back to a common point, and twisted into a handle, a loop being left at the common point for hooking in the carbide lamp. This loop should be far enough from the frame to prevent burning the paper.

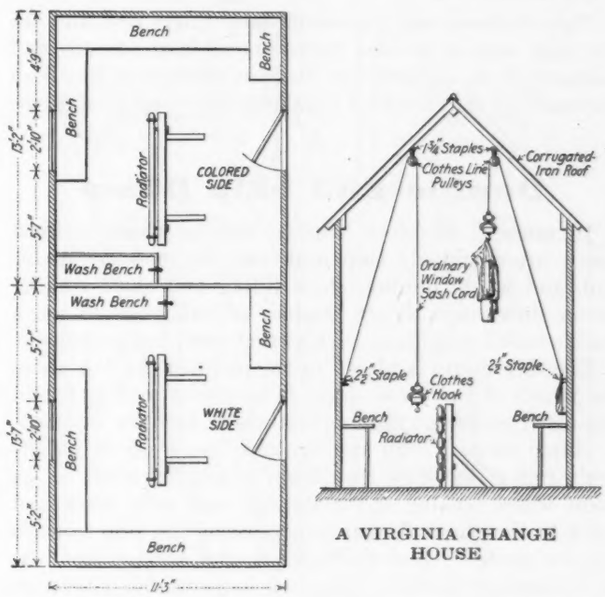
This arrangement throws the full rays of the lamp against the paper. Letter paper is cheaper than tracing cloth and serves the purpose well. The frame or handle may be turned so as to have the long side vertical, but this is not necessary, for when it is held horizontal a sufficiently lengthy view of the bob line can be secured. The advantages of this device are in its simplicity and the care of making it.

A Cheap Change or Dry House

By Roy S. Bonsib*

Although the Rich Patch Mines are among the oldest in Virginia, it has only been within the past few months that the health of the miners has received much attention. One of the largest mines in this group, No. 11, is about 1¾ mi. up the mountain from the camp, and as this mine is rather wet, the men coming from work in water-soaked clothes on cold, windy days were often laid up a week at a time with severe colds and kindred ailments. In order to eliminate or reduce the source of trouble, a shanty formerly occupied by the compressor engineer, near the mouth of the tunnel, was converted into a dryhouse, a ground plan and elevation of which are shown in the illustration.

The benches and washstands were built of boards taken from a neighboring unused shanty, the only expense being the cost of labor to get them, which was about $2. The house is heated by two home-made radiators made up of



A VIRGINIA CHANGE HOUSE

six 6-ft. lengths of 1¼-in. pipe taken from a scrap pile, connected by return bends. Steam tapped directly from the boiler was carried by 1-in. pipe 120 ft. through a wooden trough buried about 18 in. underground. A 1-in. water line was run alongside of the steam line in the wooden trough to warm the wash water slightly.

In calculating the size of radiators required for the dryhouse, the following rules were observed: Kent says that as a general rule, "one square foot of surface will heat 70 cu.ft. of air in outer or front rooms." Since the requirements were not only to heat the building, but also to provide clothes-drying facilities, it was assumed that 20 cu.ft. of air would be heated per square foot of radiating surface. Having some old 1¼-in. pipe on hand, it was found in a catalog of pipe and pipe fittings that such pipe required 2.3 lin.ft. to give one square foot of radiating surface, giving a final result of six 6-ft. lengths for each radiator.

Clothes are suspended from the ceiling over the radiators by means of a hook arrangement, pulley and

*Mining engineer, Low Moor, Va.

sash cord. Slotted openings were placed in each end of the building and the upper part of the partition between the two rooms was removed, to increase the air circulation and hasten the clothes-drying.

COST OF RADIATORS AND PIPE FITTING

Labor getting and cutting 1¼-in. pipe	$2.63
Cutting trench and fitting pipe	3.00
Twelve 1¼-in. return bends	1.77
Four 1¼- to 1-in. reducers	.20
Three 1-in. valves	5.52
Six 1-in. ells	.30
Six 1-in. tees	.30
Four 1-in. unions	.40
220 ft. 1-in. iron pipe	10.85
Total cost	$24.97

COST OF FIXTURES AND INSTALLATION

13.5 lb. sash cord	$4.05
3 doz. clothes-line pulleys	1.95
1 gross 1¼-in. wrought staples	.40
3 doz. 2½-in. wrought staples	.15
2½ doz. 2½-in. wrought hooks	.52
2 padlocks	.50
8.5 lb. nails	.30
Labor of installation	7.79
Total cost	$15.66
Cost of radiator and pipe fitting	24.97
Cost of fixtures and installation	15.66
Total combined cost	$40.63

This dryhouse easily accommodates thirty men and has not only made a decided improvement in the health and comfort of the miners, but the ore production has been increased by the increased regularity and quality of labor.

Double-End Skip Dump

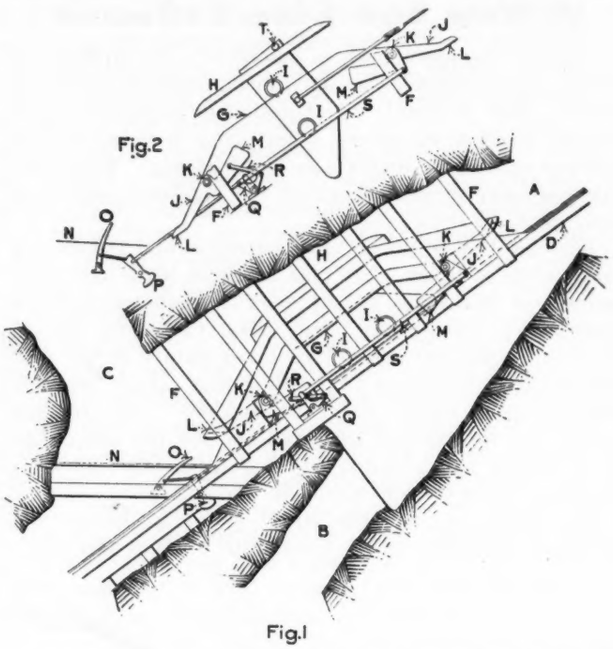
In some of the deep mining regions where inclined shafts are commonly employed, such as those in Michigan, and where mining, stope filling and shaft sinking go on simultaneously, it becomes advantageous to use a double-ended skip dump such as that described as follows:

The skip dump is placed in the inclined shaft *A* above the mouth of the waste chute *B*, as shown in Fig. 1. In the usual course of mine operations it becomes desirable to dump sand or mill tailings into the chute *B* on the down trip of the skip, then lower it into the shaft to the point where sinking is proceeding, load with muck and hoist to the chute *B* again, then lower the skip beneath the ore chute *C*, load and hoist to the surface bins. It is obvious that in the course of such operations it becomes advantageous to use a double-ended skip dump that will dump whether the travel is up or down, if desired, or allow the ready passage of a load of ore without dumping.

The dump mechanism is supported above the waste chute *B* by the track runners *D*, supporting the skip track *E*. A number of timber uprights *F* extending to the shaft hanging wall support the dumping mechanism. The latter consists of two sets of parallel guide rails *G* and *H* attached to the timber uprights. Their inclined extensions are close to the skip track, but give ample clearance for the skip wheels *I*.

Arranged to align with the inclined ends of the guide rail *G* are the bent rail sections *J*, one on each end, which are pivoted at *K* to allow them to swing down and rest upon the skip track, the ends *L* being flatted for this purpose on the under sides, which rest upon the rails, and curved upon the upper sides, which receive the impact of the skip wheels. The rail sections are supported at the pivots *K* by brackets bolted to the timber uprights and are normally held in the position shown by dotted lines in Fig. 1 by the counterpoises *M*. These two counterpoises *M* are simultaneously overcome by a system of levers hand operated by a single operator who stands on the platform *N* and throws the lever *O*.

The action of this lever is best understood by reference to Fig. 2. Movement of the lever *O* overcomes the counterpoise *P* and through the connecting-rods shown attached to the rocker lever *Q* throws the latter either forward or back. One arm of the rocker lever *Q* is attached to the nearest switch counterpoise by the link *R*,



FIGS. 1 AND 2. DOUBLE-ENDED SKIP DUMP, FIG. 2 SHOWING SKIP IN DUMPING POSITION

and the other arm to the corresponding switch counterpoise at the other end by the link *S*. It is thus seen that the throwing of the lever *O* to the right lifts the switches from the rails and allows the skip to pass through without dumping.

If the switches are down in the position shown by Fig. 2, the skip is dumped as follows: The rear skip wheels are of considerably wider tread than those of the front wheels and, as the skip descends, these wider wheels engage the curved switches *J*, thus raising them vertically over the front skip wheels and dumping the skip as shown in Fig. 2. Complete rotation and overturning of the skip are prevented by the rollers *T* projecting from the skip, which engage the upper guide rail *H* as the skip dumps.

This mechanism is the invention of Charles L. Lawton, of Hancock, Mich., granted patent No. 1,151,955 on Aug. 31, 1915.

How to Prevent Misfires, one of three questions asked by the mine-safety department of the California Industrial Accident Commission, was answered by a number of members of the Safety Bear Club, which now has an enrollment of 4,600. The best answer was decided to be the following: "To prevent misfires, take care of your powder, caps and fuse by keeping them in a dry place. The most trouble comes from making the primer wrong, avoid bringing a sharp bend in the fuse. When putting on cap be sure that the fuse has been freshly cut. For wet holes some kind of compound should be used to keep water out of the cap; if you have no regular compound, use roofing paint or common white laundry soap; never oil or grease. Wet holes should be shot soon after they are loaded."

Details of Milling and Smelting

Allen Automatic Classifier

By J. W. Crowdus*

The mill manager's search for an efficient classifier has led him through various extended investigations in recent years, first of the cone type of classifier, then of the screw or rake type. Each type has in turn enjoyed its period of rising popularity as new improvements were made, but the end is not yet, and there still seems to be a great deal of room for improvement. In his review of metallurgical progress for 1910, Alfred James states that "probably a really continuous and automatic cone, which does not clog or require continuous adjustment, would readily win the day."

As early as 1904 there was in operation at one of the well-known Arizona copper properties the forerunner of such a machine, which, though crude and cumbersome in design and action, was based on the proper principle. Used as a concentrate dewaterer and fed with all the concentrates produced in the mill, ranging from the bull-jig product to the vanner slimes, its spigot discharge contained only 22% water. It did this work without care or attention and saved the cost of four laborers over the previous method of handling. A repeat order resulted to the inventor, but the latter, wishing to furnish an improved machine, delayed filling the order till recently.

Improved Classifier of Automatic Action

The improved machine finally installed was of the design shown in section in Fig. 1, and by photo in Fig. 2. It is an automatic, free-settling, basin-type cone classifier. Briefly stated, the machine consists of a peripheral overflow cone fitted with a central open-apex truncated cone containing a float which is connected to a ball valve at the spigot.

The action of the classifier is as follows: The mill stream enters the feed spout shown at *A*, Fig. 1 and after passing through the truncated cone *B*, the mill-stream water and the solid particles carried by it flow upward and outward over the lip into the overflow launder. The solid particles too large or too heavy to be carried by the upflow into the launder settle in the large cone, accumulating until reaching the outlet of *B* when they obstruct the flow of the mill-stream water from *B* into the large cone, thereby causing the water to rise in *B* and with it the float *C* which, through the lever *D*, the link *E* and the valve arm *F*, removes the ball *G* from the spigot. Then the settled solids in the cone flow out through *G* in quantity proportionate to the area available for their passage, which varies proportionately to the quantity of solid particles settling in the cone and obstructing the mill stream flow from *B*. The settled solids in the large cone cannot lower beneath the point necessary to permit a free flow of the mill-stream water from *B* into it, and the normal shape of the basin formed by their surface is continuously maintained, insuring uniform classification. When solid particles cease settling in the cone, the discharge through the spigot stops as soon as the obstructing particles are removed from the outlet of *B*, the water in it lowering and with it the float *C*, thereby closing the valve at the spigot, the valve remaining closed and the cone full of classified particles until the mill-stream flow from *B* into the cone is again obstructed by solid particles settling from the mill stream.

The classification takes place in the basin formed by the surface of the settled solid particles in the large cone,

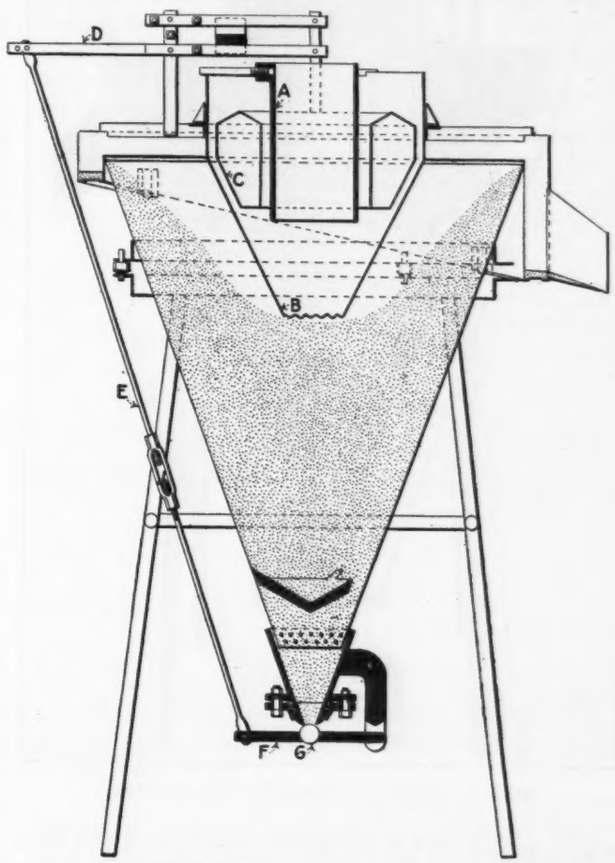


FIG. 1. SECTIONAL DRAWING, ALLEN AUTOMATIC CLASSIFIER

the shape of the basin being automatically maintained under all conditions of feed within the capacity of the cone. Should the mill stream feed more settling solid particles than can be discharged through the spigot, the basin automatically contracts, as shown at *A*, Fig. 3, until the velocity of the water flow has adjusted the abnormal feed condition. Under normal operating conditions the float controls the quantity discharged through the spigot. An increase in the quantity of settling sand or a decrease in the volume of water in the pulp-stream feed has indentically the same effect—that is, the classifying basin contracts to the point where the velocity of

*Engineer, 209 Mills Building, El Paso, Tex.

the water takes care of the altered condition. The degree of dilution of the spigot discharge remains practically the same under all conditions of feed.

If this classifier is compared with the familiar gooseneck discharge, or uncontrolled spigot-discharge cones, or pyramids using hydraulic classifying water, some of its advantages are apparent as follows: It is strictly automatic, adapting itself to all conditions of feed without attendance; the solid particles settling in the cone control their discharge through the spigot; when solid particles cease settling in the cone, their discharge through the spigot ceases; the spigot discharge has the same relative proportion of water to solids under all conditions of feed; when the spigot discharge is to be concentrated or reground, the degree of dilution is under

FIG. 2. ALLEN AUTOMATIC CLASSIFIER

perfect control since no hydraulic water is used and there is no dilution of the pulp stream; requiring no power, it can be placed anywhere in the mill without regard to lineshafting; it has fewer working parts, and its upkeep is small compared with other types of classifiers; in case of shutdown or starting up, its action is automatic and requires no supervision.

Old Dominion Test of Automatic Classifier

As an example of the work done by this new classifier under ordinary mill conditions, the results of a six-day test made by the Old Dominion Copper Mining and Smelting Co., Globe, Ariz., are given. The feed to the cone was the overflow from hydraulic classifiers, the diluted spigot discharge of the automatic cone being fed direct to concentrators of the vanner type. Samples were taken every hour. In the table is given the screen analysis and the percentage of the total copper contained in each mesh of the feed into the cone, the spigot discharge from the cone, the concentrates produced by the vanners and the concentrator tailings.

TEST OF THE AUTOMATIC CLASSIFIER

Mesh		Allen Cone Feed % Mesh Wt.	Allen Cone Feed % of Copper Contents	Allen Cone Spigot Discharge % Mesh Wt.	Allen Cone Spigot Discharge % of Copper Contents	Vanner Concentrates % Mesh Wt.	Vanner Concentrates % of Copper Contents	Vanner Tailings % Mesh Wt.	Vanner Tailings % of Copper Contents
Plus	35	0.34	....	1.12	0.40	0.00	0.00	1.1	1.37
Plus	48	0.85	0.36	2.19	0.70	0.72	0.39	3.12	3.23
Plus	65	2.60	0.48	7.92	1.57	0.62	0.33	9.42	6.12
Plus	100	12.56	2.29	28.25	5.93	2.76	1.24	39.15	25.40
Plus	150	18.28	7.22	30.36	17.83	17.25	14.78	33.12	36.30
Plus	200	11.74	9.66	13.80	18.83	18.83	18.58	8.50	14.04
Minus	200	53.63	97.99	16.36	49.51	59.82	64.68	5.58	13.54

Referring to the screen analysis of the work done by the cone, the average cyanide mill engineer possibly will not be impressed, but when attention is called to the reason for the high percentage of —200 mesh in the spigot discharge, the creditable work of the cone is apparent. As shown by the table, 59.82% of the total vanner concentrates was constituted by material of —200 mesh which contained 64.68% of the copper produced by the vanners. This very fine cupriferous material is constituted by sulphide particles which, by reason of their greater specific gravity, settled to the spigot of the cone along with the coarser gangue particles. The vanner tailings contained 5.58% of —200-mesh material. This may be assumed to be gangue and represents about 4¼% of the total amount of —200-mesh gangue particles fed into the cone. The vanners saved 81.7% of the copper in the feed, a high percentage of such fine material, due to the excellent classification and the control of the degree of dilution. The spigot discharge from the cone was composed of 71.2% solids and 28.8% water, a low percentage of water when more than 80% of the solids are —100-mesh particles. After completion of the tests, the Old Dominion company ordered five more machines. This classifier is the invention of Charles Allen, and is manufactured by the Allen Cone Co., El Paso, Texas.

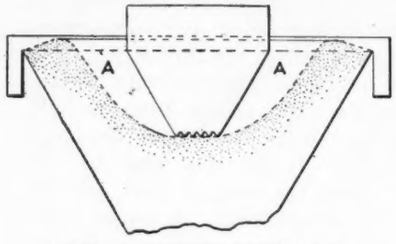


FIG. 3. CONTRACTION OF SETTLING BASIN

A Dry Ore Concentrator

An ore concentrator recently patented by L. D. Chavalier and H. C. Reche consists of an oscillating-deck table upon which the crushed ore is fed. This table is provided with air passages that conduct an upward flow of air to the under surface of the table. The resultant effect of the oscillating table surface and the upward flow of air current is the classification of the ore in accordance with its specific gravity. This is assisted by horizontal air currents which keep the partly separated mass stirred up.

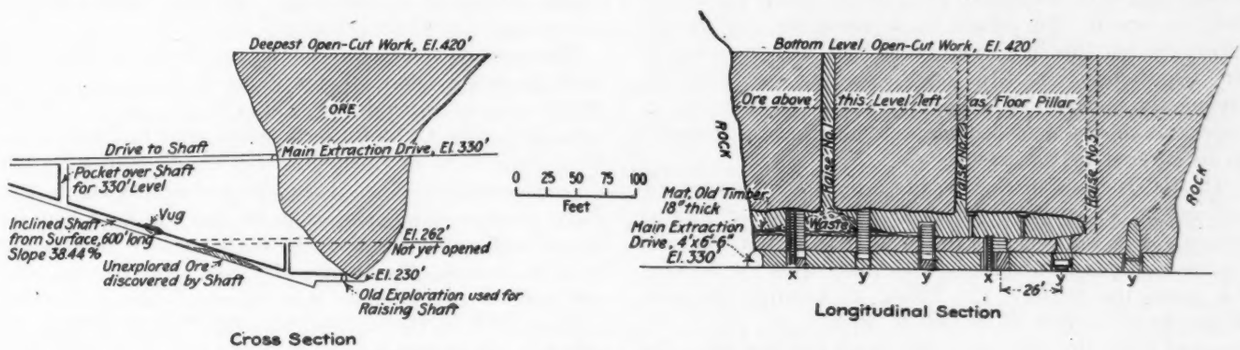
The apparatus is particularly designed for use in localities where the scarcity of water makes the usual forms of wet concentration inapplicable. This machine was granted U. S. Pat. No. 1,194,477, on Aug. 15, 1916.

Underground Mining in Cuba

By L. B. Reifsneider*

SYNOPSIS—The development and mining by underground methods of a body of iron ore is described. This is accomplished without interfering with the surface mining in progress over the area. The stopes are filled with waste drawn in through raises into the openpit, while the ore is removed through an incline whose portal is outside of the surface mining area.

The main orebody of hard red magnetite of the Vinent mines of the Daiquiri group at Daiquiri, Cuba, is underlaid in part by a separate body of black magnetite. The main body is being worked by opencut methods, and as it was desired to work out the underlying black magnetite at the same time as the main orebody, the problem of mining the deep ore without disturbing or caving the floor of the opencut work presented itself. The explorations developed the deep ore as running nearly due north and south for a length of approximately 450 ft., with a varying width of from 100 to 160 ft. and an approximate depth of 150 ft. below the lowest opencut level on that side of the mine. The deep ore is generally soft and friable and is cut at irregular intervals by dikes of rock that vary from a few inches to 20 ft. or more in width. There are also bars of very hard ore, which usually run parallel with the length of the ore. The original explorations that discovered the deep ore were put in on what is known as the 330 level, datum being taken from a point in the valley below the opencut workings.


Deepest Open-Cut Work, El. 420'
ORE
Drive to Shaft
Main Extraction Drive, El. 330'
Pocket over Shaft for 330' Level
Vug
Inclined Shaft from Surface, 600' long Slope 38.44%
El. 262' Not yet opened
Unexplored Ore discovered by Shaft
El. 230'
Old Exploration used for Raising Shaft
Cross Section
0 25 50 75 100
Feet
Bottom Level Open-Cut Work, El. 420'
Ore above this Level left as Floor Pillar
ROCK
Mat, Old Timber, 18" thick
Waste
Main Extraction Drive, 4'x6'-6" El. 330'
x y y x y y
26'
Longitudinal Section

METHOD OF UNDERGROUND MINING IN CUBA

Access to Workings Through Inclined Shaft

After careful study it was decided to use a cut-and-fill system for stoping the ore, starting on the 330 level. As there was no location on the surface suitable for sinking a shaft without interfering with the opencut operations and the grade and location of the primary exploratory tunnel were not suitable for establishing haulage, it was finally decided to sink an incline shaft, or slope, from the sidehill beyond the limits of the surface ore, locating the collar of the shaft on the surface so as to permit handling the production over one of the main haulage levels and also be able to tap the ore, which in the meantime had been developed 100 ft. deeper, at a minimum expense. While the shaft was being sunk, development work could be carried on through the old exploratory tunnel and part of the ore on the 330 level prepared for mining.

The slope has a total length of 536 ft. from collar to change of grade at the bottom. The grade is 38.44%, and it taps the deepest ore on the 230 level. So far most of the development work has been done on the 330 level. A tunnel, known as the 330 main extraction drive, 5x7 ft. in the clear, has been driven close to the contact on the east side of the orebody. This drive has been kept as close to the orebody as possible to avoid making the stoping drives in rock. The drives for the stopes are turned off at 36-ft. centers. The stopes are carried 24 ft. wide, and a 12-ft. pillar is left standing. These intervals frequently vary, for the dikes of rock mentioned are left standing as pillars wherever possible. This tends to make the stope widths irregular.

These preliminary drives crosscut the orebody from east to west. They are carried 4½x6 ft. in the clear, and usually do not require timbering. After the west wall has been reached, the drive is divided into 24- to 30-ft. sections and raises are driven at these points to a height of 8 ft. above the roof of the drive, or about 15 ft. above the rail. Every third raise is driven large to permit the installation of a chute and ladderway, usually about 4x8 ft. The intermediate raises are cut only 4x4 ft. for chutes alone.

Stoping is then started from the double-size raises, leaving a stope floor about 6 ft. in thickness above the roof of the preliminary drive. As the stopes open out, the carloading chutes and the ladderways are cribbed and the ladders installed, and as the stoping progresses, the other raises are broken into and the loading chutes installed in them. Experience has shown that by putting the chutes at 25- or 30ft. centers the ore can all be shoveled and no wheeling is required, considerably increasing the production. The first cut in the stope is carried the full width, 24 ft., and 9 ft. in height. If heavy back is encountered, as frequently happens, the ore being threaded with horizontal cleavages, props or bulkheads of old timber are placed as needed.

As soon as the stoping has advanced sufficiently, raises to surface are started, so that by the time the first cut is finished, preparations for running in waste for filling

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the worked-out ground may be well under way. As this ore underlies the surface working, the raises are therefore put up primarily so as to require as little rehandling of the waste for stowing it in the stopes as possible, about three raises being carried to surface for a stope 150 ft. long. The waste that is used in filling is waste that is hand-loaded in mining the surface ore, and instead of being hauled to the waste banks is dumped into the stopes. Before fill is run into any stope, the cribs and manways are built up to the back and a mat of old timber is laid on the stope floor, so that when mining up from the lower level, this old timber mat can be caught up and supported until all the ore is worked out, just as would be done in a caving or top-slicing system.

A 23- to 25-ft. floor pillar is left to support the floor of the surface workings, the stoping being carried up the 405-ft. level. The floor will later be recovered by surface methods. After the stopes on each side of a pillar have been worked out, the pillar is attacked. A preliminary drive is put in as in a stope and the manways and cribs started. In place of putting up a raise to the surface to draw in the fill, however, the fill is drawn from the worked-out stopes on each side and this fill is replaced by continually dumping waste into the stopes as it is drawn to fill the pillar. Care must also be taken not to take the slices in the pillar too high, or trouble will be encountered from having the waste from the sides run in and mix with the broken ore. There is also a tendency for the ore in the pillars to separate on the natural cleavages, but this in a way is beneficial, as less explosives are required to break the ore to loading size, although frequently considerable ingenuity has to be exercised in order not to lose detached pieces, which have a tendency to be covered by the waste.

On the last cut in a stope the cribs and manways are carried up to support the floor pillar, and as mining progresses in working out the ground from the 230 level up, connections will be made with these cribs for drawing fill from the surface for filling as mining proceeds. Water to the extent of 20,000 to 30,000 gal. per day is pumped from the 230 level, the larger amount being the average during the rainy season. Two small duplex pumps having 2½-in. suction and 2-in. discharge handle the water. These are operated by compressed air at 80 lb. pressure. Only one pump is in use, the other being held in reserve. The water is pumped to the 330 level and from there is piped out through the old exploratory drive.

Mining by Contract

All mining and driving is done by contract. In the stopes the miners are paid 30 to 35c. per ton for the ore delivered in the ore chutes, from which they pay for dynamite, caps, fuse and carbide. No deductions are made for tools, air or spare machine parts. They work a 10-hr. shift and average $2.35 per day. Trammers work on a premium system based on a rate of $1.50 for 10 hr. and as a rule make $1.95 per day. The cost of ore delivered at the slope, exclusive of timbering and overhead charges, is 41.3c. per ton. Explosive costs vary. In the first stoping cut, where the ore is blasted off the solid wall, about 1.4 tons of ore is broken per pound of dynamite used. After the ore has been undercut, the proportion rises to 2.7 tons per lb. Flat holes are used entirely in stoping, as it has been found that 100% more timber is needed if stoper drills are used. The tendency of the upper holes to leave a bad back is proverbial, but it is particularly aggravated in this formation by the many horizontal cleavage planes in the ore. The preliminary drives for the stopes are paid for on an average of $4 per lin.ft. of drive, the miners doing their own tramming and delivering the material either in the pocket on the slope if ore, or tramming it outside if waste.

Hard Seams Occasionally Encountered

The raises for filling are always carried up 5x7 ft. in the clear until near the surface, where their size is reduced. The reduction in dimension prevents jamming of rock in the raise when large rocks are dumped with the other waste, as frequently occurs. The raises cost $5 per ft. Occasionally one of them strikes one of the particularly hard seams of ore, and then the price may rise to as high as $8 per ft. In one of the raises recently driven, one of the hard seams was encountered. Eighteen holes were needed to break a 6-ft. cut in a 5x7-ft. area. To blast the center and cut holes 60% semi-gelatin dynamite was used and occasionally the holes were reloaded three times before they bottomed satisfactorily. After the cut holes break out, no difficulty is experienced in breaking out the balance of the round with 40% powder. The men working in raises place their own stages and ladders and pay for their dynamite, fuse, caps and carbide, the same as the miners in the stopes. They do no mucking. Their average earnings on contract are $2.38 per day.

The machines used in stoping are Ingersoll-Rand 2B drills in soft ground, 3¼-in. drills in hard ground and MC32 stopers for raising. The 3¼-in. drill is being replaced by the C116 Butterfly-valve machine, which has been found to be as effective as the 3¼-in drill with less air consumption. When it was decided to sink the incline shaft, or slope, the explorations on the 230 level had advanced sufficiently to allow the shaft work to be attacked from the bottom. Two gangs of 3 men each, two machine men and one chuck-tender were therefore started, working a 10-hr. shift at the top and bottom. The ground at the top was soft and had to be carried in timber, steel drift sets consisting of a 9-in. I-beam cap with 6-ft. clearance and 5-in. H-section posts, 8 ft. high, giving 7 ft. clearance over the skiprail, were used. The gang sinking did their own mucking and timbering. The ground, while requiring timbering, was firm and allowed us to carry the face from 10 to 12 ft. ahead of the timber. Two 2B machines on a vertical drift bar were used for drilling, 8 holes usually being required to break a 7-ft. cut. Practically the same kind of ground was carried clear from the collar to within a few feet of the 330 level. The timber sets were placed on 5- or 6-ft. centers.

At the bottom, or 230 level, conditions were different. The first 35 ft. of the raise was driven in a hard porphyritic diorite. Two 3¼-in. drills were mounted on one column, and when necessary, an extra machine was rigged in on another column in order to drill over the face. Eighteen to 22 holes were required to break a 5-ft. cut. The material, besides being very hard, was badly fissured, and it was with difficulty that a hole could be drilled to its required depth. From 70 to 80 well-tempered bits were required for the round, and very often more were used. The fissured material broke well, however, and as the bottom holes were shot last, the muck was thrown far enough down the slope so that very little

work was required to clear the face for the next set-up. At 35 ft. from the change of grade, the back of an unexpected orebody was encountered. For 55 ft. the ore was encountered in the floor, at times rising to 5 or 6 ft. in height in the face. The value of the ore made selective blasting necessary and considerably delayed the work. The ore was mucked out before the rock was blasted. All the material from the lower part of the slope was trammed to the old exploratory shaft and there rehandled with a bucket to the 330 level and from there trammed to surface. As there were enough tramcars on hand, no delay was experienced in the actual raising, but an additional expense of two trammers and a hoistman was incurred.

The shaft was carried full section for 90 ft. from the bottom, when a vug was encountered. This also marked the end of the ore. The ground in the vicinity of the vug was very insecure, and it was decided to reduce the area to 5x7 ft. until the bad ground was passed and enlarge it to the required area afterward. After passing the vug, the same material that had been encountered at the bottom was again met and continued until the two headings were connected.

Slope Driven from Three Points

While the sinking and raising had been going on, a drive to the slope had been started on the 330 level and reached the vicinity of the slope before either of the headings had reached that elevation. It was decided to start sinking and raising from the latter working, and 8 ft. was sunk and 16 ft. raised from there. When the three headings were finally connected, there was a deviation from the engineer's points of ¾ in. in elevation and ½ in. in line. Considering the conditions, this was a good connection.

The cost of the slope, including everything but engineering, superintendence and compressed air was as follows:

COST DATA OF INCLINE SHAFT

	Per Ft.
Labor (contractors, hoistmen, timbermen and trammers)	$8.386
Light and explosives	1.338
Timber, including steel sets	1.954
Supplies (steel, drill repairs, etc.)	1.463
Total	$13.141

After the slope was finished, a raise was put up under the 330 level, to be used for a pocket. Several sets of steel timber were placed under the raise, an arc door was fitted and a pocket of 125-tons capacity was made. The work of cutting the pocket, installing the steel and placing the timbers for the grizzly at the top of the pocket, including cutting the hitches, cost $214.30.

About the time this work was finished, the depression in the iron-ore demand compelled the curtailment of production and the work was temporarily abandoned. All the labor employed was Spanish with Spanish foremen.

Miami Copper Co.

The report of the Miami Copper Co. for the first half of 1916 shows a total production of copper of 26,931,915 lb.—4,097,333 lb. in January, 4,141,286 lb. in February, 4,459,783 lb. in March, 4,330,882 lb. in April, 4,978,243 lb. in May and 4,924,388 lb. in June. The smelter production of 5% gives a net production of 25,585,314 lb. of merchantable copper. The average assay of the ore was 2,086% copper, and the concentrator extraction was 71.44% of the copper. The saving of copper was 31.38 lb. per ton of ore, or net after smelter losses of 29.81 lb.

Improvements at the concentrator will include the replacement of the three chilean mills in Section 5 by two large Hardinge mills using steel balls, with the object of bringing the capacity of the section up to 1,000 tons per day.

Gross income was $5,810,357; total costs, $2,310,617; leaving profit of $3,499,740. Dividends Nos. 14 and 15, amounting to $2,054,564, were paid, leaving a net surplus of $1,445,176 for the half-year.

Lead-Zinc Mining in Virginia

By F. B. Speed, Jr.*

The results of the recent development work at the Holladay mine of the Virginia Lead and Zinc Corporation in Spotsylvania County, Virginia, are directing attention toward this district as an important producer of lead and zinc ores. This region, which has for many years been the largest producer of pyrite in the United States, has also been worked intermittently for iron, copper and gold for two centuries, but it is only within the last few years that the presence of lead and zinc sulphides in workable quantities has been known. The overlooking of the lead and zinc deposits for so many years, while perhaps unfortunate from an economic point of view, is not unnatural when the history of the district is known.

Early in the Eighteenth Century the limonite gossan ores were used for the manufacture of pig iron in charcoal furnaces which were erected near the ore deposits. Since the bodies of iron pyrite would yield in their gossan outcrops larger quantities of iron ore than bodies of sulphides other than pyrite, the leaner gossans were neglected by the iron miners. In mining the richer gossans the pyrite bodies below were discovered, and their development was started many years ago. Recently, however, the prospecting of some of the leaner gossans has disclosed the presence of workable lead and zinc bodies, which are now being actively developed. At present there are two producing lead and zinc mines in the district—the Allah Cooper, in Louisa County, about 5 mi. northeast of Mineral, Va.; and the Holladay, in Spotsylvania County, about 10 mi. farther to the northeast.

The belt in which the sulphide bodies occur is well defined, striking in a northeast-southwest direction and having an average width of 4 to 5 mi. The rocks of the belt are schists of probably Lower Cambrian age, which are principally of the quartz sericite type, although chloritic and hornblendic types are not uncommon, and in places there are calcareous varieties. The structural lines extend parallel to the general strike of the belt, and the dip of both the bedding and foliation is mainly to the southeast, although reverse dips occur.

The larger orebodies occur in the less siliceous portions of the schist series and occupy fissured positions. Replacement of the wall rock by sulphides on the hanging-wall side chiefly is characteristic of the deposits, the foot wall being usually well defined, and the hanging wall less so. In places this replacement has been very extensive, certain of the orebodies showing a thickness of 60 ft. or more. The presence in association with the sulphides of such

*Charlottesville, Va.

minerals as horneblende, garnet, pyrrhotite and zinc spinel classifies these occurrences as high-temperature deposits.

Development of the Holladay lead and zinc property, which was undertaken by the Virginia Lead and Zinc Corporation in December, 1915, has disclosed a large body of rich ore. The property is being developed through two shafts 1,300 ft. apart, and in all about 800 ft. of drifting on the orebody has been done. As a result of this work the dump shows about 6,000 tons of ore, while the ore brought in sight is conservatively estimated at 50,000 tons, and the probable reserves many times this amount.

At the present time the ore is being sold for the manufacture of paint, and shipments are being made at the rate of 30 tons per day, which is about half the present output of the mine. An idea of the quality of the ore may be obtained from the fact that that sold during the past month was settled for on the basis of 22% combined lead and zinc. The construction of a standard-gage railroad 10 mi. long to connect with the Chesapeake & Ohio Ry. near Mineral, Va., has been started, and a 100-ton concentrating mill is being planned, the construction of which will probably be under way at an early date.

As previously pointed out, the district is highly fissured and mineralized and offers a most promising field for further prospecting, which has already been begun. Intelligent work along these lines will no doubt lead to the further development of this district, which may be considered as having much promise of becoming an important producer of lead and zinc.

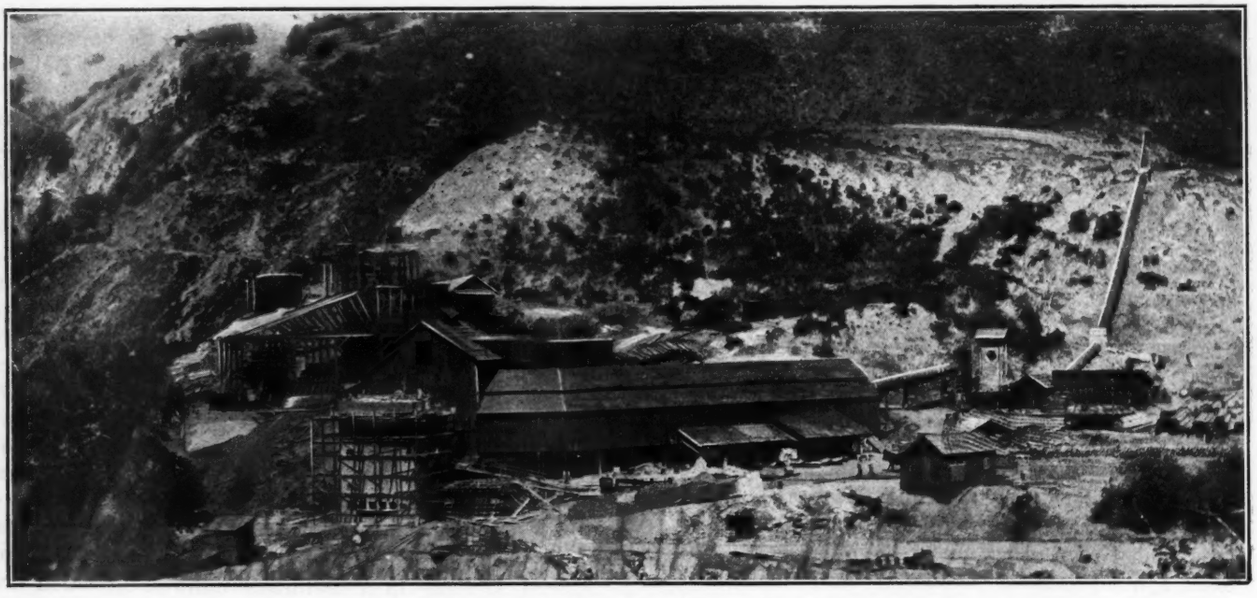
Iron Ore Movement on a great scale from Ashtabula Harbor on Lake Erie to Pittsburgh is reported by the Pittsburgh & Lake Erie R.R. On June 10 the railroad unloaded from vessels and loaded into cars for furnaces 1,609 carloads of ore, besides putting 125 carloads on the docks. Of the 1,609 carloads, 1,385 were for blast furnaces in the Pittsburgh district. These cars were unloaded by noon June 12, and were returned empty that night for reloading at the harbor at Ashtabula. On one day recently the Pittsburgh & Lake Erie moved a solid train of 99 cars, with a gross tonnage of 7,586, of which about 4,800 tons was ore, all consigned to the blast furnaces of the Jones & Laughlin Steel Co. at Aliquippa.

Oceanic Quicksilver Mill

EDITORIAL CORRESPONDENCE

The new construction work at the Oceanic quicksilver mine at Cambria, San Luis Obispo County, Calif., includes a receiving bin, 150 tons capacity, at the mine; aërial tramway, capacity 300 tons in 10 hr.; concentrating plant, 200 tons capacity in 24 hr.; and a new 50-ton Scott furnace, with condensers. This was rush construction, having in view a greatly augmented treating capacity during a period of high quicksilver prices. The entire concentrating plant was in commission in 2½ months. All the materials of construction had to be shipped by water to San Simeon, the port of San Luis Obispo County, and from there had to be hauled by motor trucks over a 16-mi. road inland to the mine.

The ore is received at the concentrator in a coarse-ore bin of 200 tons capacity. After being crushed and before being lifted to the main storage bin of 800 tons capacity, the crushed ore is passed through screens having 2-in. square openings which separate the coarse ore from the minus 2-in. material. The minus 2-in. goes to the two 50-ton Scott furnaces, and the 2-in. oversize is fed to two 5x4-ft. ball mills, the product of both mills being pumped to the sizing screen, making 10-, 20- and 35-mesh products. The oversize from the sizing screen is returned to one of the ball mills, the different screen sizes being treated on Overstrom sand tables. The 35-mesh product is passed over a 60-mesh duplex Callow screen, and the undersize of this Callow screen passes over a 100-mesh duplex Callow screen. The undersize of the 60-mesh and the oversize and undersize of the 100-mesh Callow screens pass through 5-ft., 6-ft. and 8-ft. Callow settling-out tanks respectively, and the thickened pulp from these tanks is treated on Deister slime tables. The overflow water from the settling-out tanks is returned to the sand pumps that handle the pulp from the ball mills.



CONCENTRATING MILL UNDER CONSTRUCTION AT OCEANIC QUICKSILVER MINE

The quicksilver occurs as cinnabar in sandstone and mudrock, and the ore requires fairly fine grinding to secure a commercial extraction. The extraction varies somewhat with the quicksilver content of the ore, being

higher with a better-grade ore. The concentration ratio is about 20:1. The concentrates are at present sun-dried and treated in the Scott furnace.

At the furnace plant a 50-ton Scott furnace was added to the one already in use, together with a two-compartment brick condenser and two large wooden condensers. The wooden condensers are built with tongue-and-groove floors and tongue-and-groove redwood sides and roof; they are 16 ft. wide, 40 ft. long and 23 ft. high and give ample cooling and condensing space.

The new tramway furnishes the ore for both condenser and furnace. It is 2,600 ft. long and is equipped with a 1⅛-in. carrying rope on the loaded side, a ⅞-in. rope on the empty side, a ⅝-in. traction rope and 10-cu.ft. buckets.

The machinery, including the ball mills and crushers, was built by the Joshua Hendy Iron Works, San Francisco. The American Steel Wire Co. furnished the tramway-rope equipment. The Deister Concentrating Co. furnished the Overstrom and Deister tables. The machinery is driven by a 165-hp. gas engine made by the Bessemer Gas Engine Co. Herbert Haas, of San Francisco, was construction engineer.

It is anticipated that the Oceanic quicksilver mine will be one of the larger producers in the state, with a monthly output of 400 flasks. The company is sinking a new two-compartment shaft to a depth of 400 ft. The hoisting compartment is 4 ft. 6 in. by 5 ft., the manway 4x5 ft. The collar of the shaft is situated on the main extraction adit level. Arrangements are being made for electrifying the entire plant. It has not yet been decided whether the electric current will be generated at the mine or purchased from the San Joaquin Light and Power Co.

Japanese Mines Output in 1915

The production of Japanese mines in 1915, according to a leading Japanese paper the *Chugai Shogio,* was valued at 175,950,000 yen, a gain of about 13.5% over the production of 1914. This figure does not include the production of the Government Iron Works, known to be greatly increased, through coöperation with the Russian government in supplying was munitions. As shown by the accompanying table, the majority of the items produced enjoyed substantial gains both in quantity and value of the product. The greatest individual gain was made by refined antimony, whose quantity was increased 116% over 1914, totaling 8,320 metric tons, whose value was 747% greater than that of 1914. Metallic zinc scored similar gains in jumping the quantity 274% and the value 841.8% over those of 1914. Other items making large gains in quantity were those of tin, 253%; wrought iron, 69%; pyrite, 41.7%; chromite, 41.3%; manganese, 51.5%; scheelite, 90.9%.

MINERAL PRODUCTION OF JAPAN, 1915

(Official statistics according to "Chugai Shogio")

		Percentage Increase Over 1914	
	Amount	Amount	Value
Gold, kg.	8,213	16.2	15.0
Alluvial gold, kg.	80		
Silver, kg.	159,261	5.5	1.5
Copper, m.tons	75,415	7.0	37.5
Lead, m.tons	4,764	4.4	18.0
Bismuth, kg.	1,074		
Bismuth ore, m.tons	21		
Tin, m.tons	341	253.3	254.2
Antimony, refined, m. tons	8,320	116.0	747.0
Antimony, crude, m.tons	27		
Mercury, kg.	38		
Zinc, metal, m.tons	21,131	274.0	841.8
Zinc, ore, m.tons	6,121	56.9*	27.8
Pig iron, m.tons	64,897	12.2*	8.9*
Wrought iron, m.tons	1,168	69.0	67.0
Steel (except government works), m.tons	16,741	8.9	34.0
Pyrite, m.tons	67,536	41.7*	36.8*
Chromite, m.tons	2,979	41.3	109.7
Manganese, m.tons	25,870	51.5	96.8
Scheelite, m.tons	352	90.9	154.4
Wulfenite, m.tons	11		
Wulfenite, crude, m.tons	10		
Arsenic, kg.	14,885		
Phosphate, m.tons	57,723	50.9	18.0
Graphite, m.tons	666	16.0	32.5
Coal, m.tons	20,490,702	8.1*	19.0*
Oil, liter	470,390,580	10.8	4.6
Asphalt, m.tons	1,975	1.5*	1.5*
Sulphur, m.tons	61,405	2.6	5.0*
Sulphur, ore, m.tons	17,174		

* Decrease

Tungsten in the Assay for Lead

The recent great interest in tungsten and its recognition in districts where its minerals had not been known to occur lend a new interest to a paper by Herbert Lavers ("Proc. Aust. Inst. M. E.," N. S. No. 10, 1913) in which is discussed the influence of tungsten on the ammonium-molybdate assay for lead. In a certain sample negative results were obtained for lead, but after removal of the tungsten a figure of 9.8% Pb was obtained.

The interference seems to be due to the following cause: When the lead sulphate obtained by ordinary methods is dissolved in ammonium acetate, lead acetate is obtained. The titration reaction is then as follows:

$$Pb(C_2H_3O_2)_2 + (NH_4)_2MoO_4 = PbMoO_4 + 2NH_4C_2H_3O_2$$

When the ore contains tungsten, this is converted into trioxide by action of the acids, and during solution with ammonium acetate it combines with lead thus:

$$Pb(C_2H_3O_2)_2 + (NH_4)_2WO_4 = PbWO_4 + 2NH_4C_2H_3O_2$$

So that if sufficient tungsten be present in the ore to combine with all the lead present, the addition of the standard solution gives negative results.

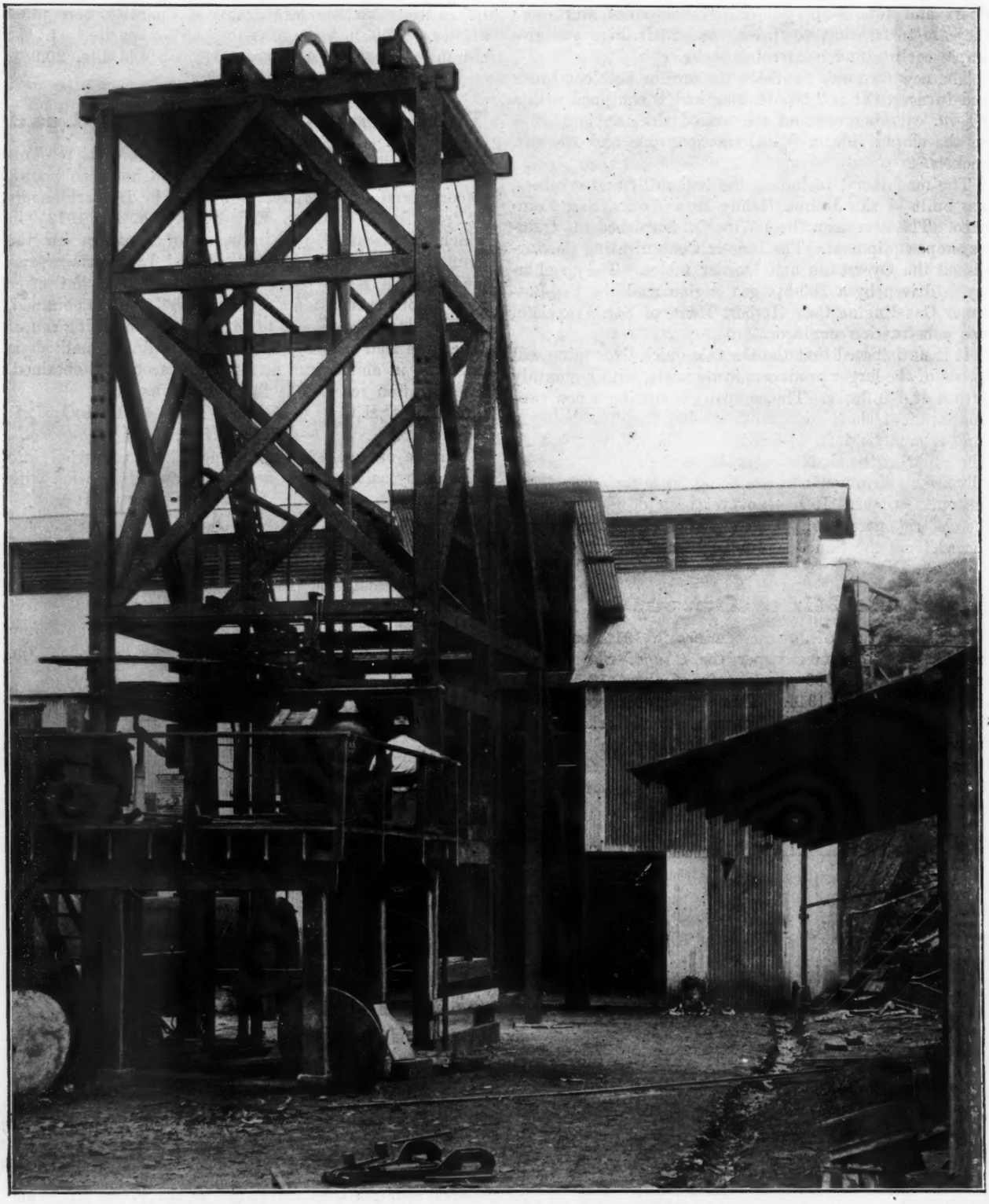
It is therefore necessary to remove the tungsten before proceeding with the lead assay, and this is done in the following way:

The ore is digested in 10 c.c. HCl, 10 c.c. HNO_3 added and evaporated to small bulk. This is taken up with water, boiled, allowed to settle and filtered. By this means the tungsten is converted into tungstic acid and removed with the silica. To the filtrate is added H_2SO_4 taken to white fumes and the assay proceeded with in the usual manner.

The reaction between lead acetate and tungstic acid suggests a rapid volumetric method for the estimation of tungsten. The tungstic acid obtained on the filter paper with the silica is dissolved in ammonium hydroxide, neutralized with acetic acid and an excess of standard solution of lead acetate added. This combines with the tungsten as already shown. The excess is then titrated with ammonium molybdate and the difference calculated to $PbWO_4$. Tungstic acid has no effect on the zinc assay. The method is simple and satisfactory.

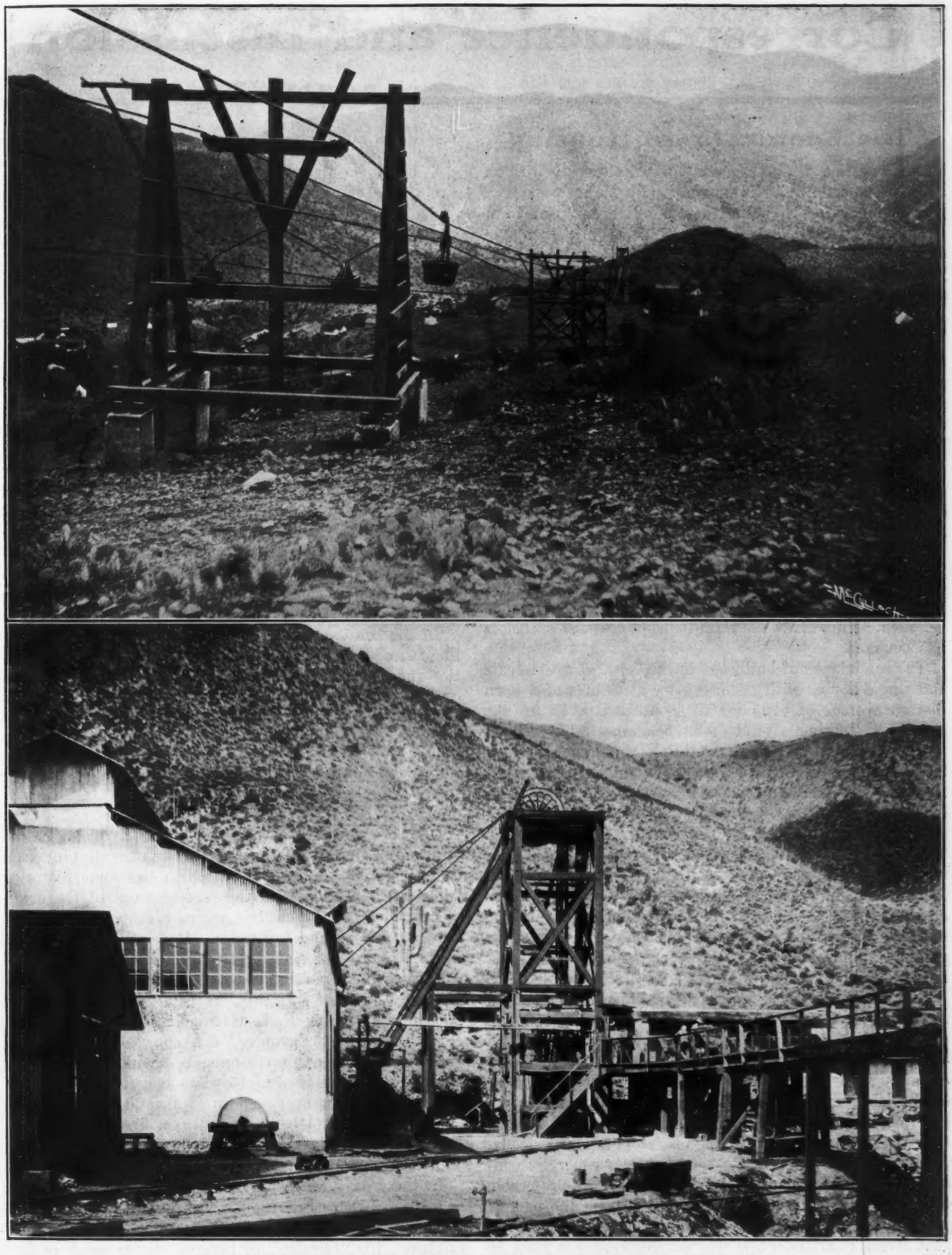
Wolframite in Argentina, says a recent Argentine official report, is found almost exclusively in veins of quartz with mica. The regions which present such veins or where they may be expected to be found belong to the geological group of the Pampean hills. The most important of all the mines of wolframite in the Argentine Republic is situated on the east side of the Sierra of San Luis, west of the village of Dolores, near the Concarán station of the Pacific Ry. This mine belongs to a company which for more than 10 years has been exploiting the wolframite, including small quantities of scheelite."

Photographs from the Field



HEADFRAME OF THE CHRISTMAS COPPER MINE, NEAR CHRISTMAS, ARIZ.

This property was acquired by the American Smelting and Refining Co. about two years ago. It was formerly owned by the Saddle Mountain Mining Co., in which New Haven people were interested; later by the Gila Copper Sulphide Co.



CHRISTMAS TRAMWAY AND SIDE VIEW OF THE MINE HEADFRAME

A 7,000-ft. Bleichert aërial tramway connects the Christmas mine with the siding near the terminus of the Phœnix & Arizona Eastern R.R. The ore is shipped to the American Smelting and Refining Co.'s plant at Hayden, Ariz., about 20 mi. distant. The properties are in the southern part of Gila County

Correspondence and Discussion

The Economics of Housing

The question of housing company employees is of more or less importance to most industrial plants, but is of prime importance to mine plants, which are usually located in uninhabited regions where practically the entire force has to be housed in company quarters.

After completing the housing facilities for 5,000 to 6,000 employees in a previously unpopulated region, it seems that the entire problem was one of economics purely and simply. The correct understanding of the factors entering into the question and their proper weight were the prime considerations. The construction of club building, welfare building, etc., was not based on philanthropy so much as on business economics. For the better understanding of the subject, a few deductions might prove interesting.

In an unpopulated region where men work on shifts there are very few sources of interest outside of the work itself. Unmarried men living in bachelor quarters soon become restless and many leave for a more interesting existence. In one instance housing facilities in bunkhouses for 4,000 men, four in a room, cost $21 per man. The only outside interest was a welfare building that cost $4 per man. This made the total housing cost for bachelors $25 per man.

The same types of buildings in the form of apartments and single houses with the necessary attributes of a town cost an average of $725 for the house and $250 for the attributes, making a total of $975 against $25, or $950 more per man required as an initial investment. Now consider the income received on the investment. Rent for the bunkhouse is charged at the rate of 50c. per week or $26 per year, so that (allowing 2% for repairs) the income per man is $25.48, while the total initial cost is $25. This is equivalent to amortizing the houses in one year besides the necessary repairs. In the case of the married men the total value of the property is taken as the principal and 8% is charged on this, divided into twelve monthly payments; 2% is set aside for repairs. This gives an interest rate of 6% on the company's investment; but the ultimate redemption of the capital is problematic.

Summing these facts up, unmarried men can be housed at an initial cost of $25 per man with capital redemption within a year. Married men are housed at a cost of $975 with interest at 6% and redemption of capital uncertain. These conditions obtaining, a canvass is made of the labor requirements in all the departments of the enterprise. A study of conditions in similar places shows that a certain proportion of the operators must be steady, reliable, sober, skilled and satisfied. It is generally conceded that married men comfortably housed are preferable to bachelors with their occasional lapses from the narrow path. The elder members of the staff are entitled to good living quarters, while the younger members must be housed in a hotel or boarding house. Semiskilled labor is satisfied for a year or so in bunkhouses, but usually becomes dissatisfied and changes if housed under these conditions much longer. If their places are easily filled by an abundance of labor and the operations are not hindered to too great an extent by the breaking in of new hands, this is not a great loss.

It is usually the policy of a company to keep a more or less constant ratio between the married and unmarried men and provide accommodations to suit. The unskilled labor encountered during the construction period is most economically housed in bunkhouses. The better men can be picked for operators at the end of construction and their quarters provided if they are married. The rule prohibiting unmarried men from having houses is a good one, as an unmarried man with a house causes all the expense of a married man without any of his assumed stability. It is well to remember that public buildings, such as railroad stations, churches, schools, etc., are entirely nonrevenue producing, while semipublic buildings are good revenue payers. A Y. M. C. A. building, clubhouse or bowling alley will pay for itself in a remarkably short time. In this connection I would recommend, from an economic standpoint, an increase in the latter type of building for spare time rather than the first. A Y. M. C. A. building can be run by a broad-minded man with equal benefit to that of a church and to greater advantage.

In the construction of a new plant from 5 to 15% of the cost of the plant should be allowed for housing facilities and the distribution of this amount should be based on the requirements and limitations indicated.

New York, Aug. 1, 1916. F. W. FREDERICKS.

Blast-Furnace Tapping by Electricity

One of your correspondents, J. C. Welch, in the *Journal* of May 27, 1916, gives a copy of a clipping from the *Greenwood Times*, B. C., which has some historical value in connection with the ferreting out of the origin and first use of the electric arc in the opening of blast-furnace tuyeres and tap holes. It seems, however, that the first source of such information has been neglected. I refer to the *Transactions* of the American Institute of Mining Engineers. In Vol. 31 (1901), page 626, there appears a paper by F. L. Grammer, on "The Electrical Burner for Blast Furnaces." A copy of this paper is given herewith, and no comments should be necessary. The Transactions, even of 15 years ago, form an authoritative record of things metallurgical, and in an instance of this kind cannot be neglected as a first source.

Rancagua, Chile, July 24, 1916. VERITAS.

Mr. Grammer's paper says:

In these days, when anthracite is less extensively used as a blast-furnace fuel than it was a generation ago, and managers endeavor to maintain regular and known ore mixtures, the "freezing" of tuyeres, cinder notch or iron notch is infrequent and consequently the oil-burner or "kerosene blowpipe" is seldom employed and furnace foremen have, to a considerable degree, forgotten their

former cunning and persistency in the use of the drill and sledge. Still, in starting new or abandoned plants with untrained labor and in running some of our large 100-ft. furnaces, slips, resulting in very cold furnaces, may occur even under experienced managers.

During my superintendence of the Cleveland, Ohio, blast furnaces, such a misfortune, owing to a dearth of trustworthy foremen, was experienced and our electrician, Thomas Martin, proposed to open the tuyeres and cinder notch by means of the heat of the electric arc. We have heard that the surface cracks or marks developed in rolling heavy plates have been closed by electric welding, as by a soldering iron, and also that an electric burner has been employed at some German blast furnaces, but the experiment was quite novel to us, and I think it constituted one of the first, if not the very first, successful application of this device for the purpose named, in the United States.[1]

In the construction of the circuit we attached one wire to a pipe, feeding a cooling block of the furnace wall, some distance from the point where the burner was applied. The current from this wire passed either through the crucible or through the circumferential shell. The other wire, after running through a resistance coil immersed in a barrel of water, was attached to clamps holding the carbon, the latter being inserted in an iron pipe provided with a wooden handle and applied at the desired point by the goggled operator.

Our first experiments were not very successful. We used 1.5-in. carbons, 1.5 ft. long, not being able at the moment to obtain larger ones. Subsequently, we had carbons made 4 and 6 ft. long, and with these we burned a hole through 18 in. of cold iron in 5 minutes. A current of from 400 to 500 amp. did the work, but 1,000 amp (at 80 volts) gave better results. Our two dynamos were General Electric, with 110 kw. capacity and 220 volts. We reduced the voltage by means of a resistance coil of german silver wire.

The results were so satisfactory that permanent wires were strung up to the furnaces,[2] and "hard holes" at tapping time, requiring slackening of wind, are now an evil of the past.

Water-blocks sometimes leak and flood a side of a furnace, closing several tuyeres and causing one-sided working. But by putting blanks on the penstocks temporarily out of use, the blast can be kept on the furnace while the closed tuyeres are burned open. Several furnaces on the Lake fronts used it successfully, after hearing how it had assisted us.

The electric current employed is not dangerous to the workman, and the apparatus, unlike the oil-blowpipe, is always ready for service. It can be applied instantly to a black, cold surface, without the need of any blast pressure —a boon which will be appreciated at single stacks, where the freezing of the tuyeres may have made it difficult to get the necessary pressure, by affecting the gas supply to the boiler house.

The saving in oil, worn-out men, drills and time commends this simple and effective burner as the best. We may say of this apparatus what used to be said of a dress coat or a pistol—that "it is not needed often, but when it is needed, it is needed awfully." Plants not equipped electrically can use the power of a neighboring municipality or other works, employing a rotary transformer to obtain the desired current. Both the holder of the burner and the curious spectators should wear the darkest glasses, such as are worn by heaters—or twelve hours of great suffering will be the penalty.

A Bryn Mawr graduate, in describing the bessemer converter, which she had just seen for the first time, remarked that she was much impressed with the "intense molecular activity" there displayed. This pedantic but accurate description applies with still greater force to the electric-arc burner, as those who are so foolishly enthusiastic as to watch it with unshielded eyes will be forced to confess.

Origin of Sudbury Nickel-Copper Deposits

In the *Journal* of May 6, 1916, Cyril W. Knight offers a very interesting contribution on the "Origin of Sudbury Nickel-Copper Deposits." Though his discussion is brief, yet as new evidence bearing on the origin of the Sudbury ore deposits, it probably should rank as the most important contribution offered since Doctor Barlow's and Doctor Coleman's monographs were published several years ago.

Doctor Coleman's later discussion, in the *Journal* of July 8, adds nothing to his views as expressed in his monograph and in subsequent discussions in the *Journal*. The feeling is hardly avoidable, however, that in his latest discussion he fails to allow to Knight's contribution the weight that it deserves.

Whatever value may be attached to Knight's observation or to any that may in future be made, the importance of Doctor Coleman's work will remain untouched. His monograph, containing his generalizations as to the norite laccolith and as to the general positions of the nickeliferous orebodies, will remain a classic. His maps will still be found in the outfit of every prospector in the district. The hard, faithful, accurate and honest work done by Doctor Coleman and his assistants will still be as highly appreciated as before by those best in position to value the accuracy of the work they accomplished. But a scientific theory is merely a theory and serves its best purpose when it acts as a stimulus and guide for further research. It becomes merely a mental stepping stone should later ascertained facts not prove to be in harmony with it.

I am acquainted with a number of technical men who have held Doctor Coleman's geological work in very high esteem, but who have never been convinced of the probable correctness of the theory of magmatic segregation as accounting for the origin of Creighton, Whistle, Levack and other orebodies in this district. If Knight's observation of numerous apophyses branching into the norite from the parent granite mass, in Graham, Creighton and Snyder Townships, is correct (and this is a matter that any geologist can easily disprove if Knight is incorrect), then it will be difficult to believe that the present Creighton orebody was formed by the settling of sulphides under the action of gravity before the norite

[1]The principle was very clearly stated in 1891 by Prof. J. W. Langley, ("Trans.," XX., 252, who said that in the course of experiments upon fusion in an electric-arc furnace, it happened on several occasions that the arc from the end of a carbon rod struck squarely in the center of a lump of steel about as large as a hen's egg, and that "in a very few seconds that arc would bore a hole through that piece of steel, the corners of the steel being still so cold that, when seen through the dark spectacles that one had to wear, they appeared to be black." I am informed that a similar device has been used by safe robbers.

[2]The low potential requires a heavy copper wire.

mass solidified. Doctor Coleman's suggestion that the later (in place of earlier) intrusion of the granite has little or no bearing on the manner in which the Creighton orebody was formed, I feel, can only convince those who are differently constituted mentally from myself.

That the nickeliferous deposits bear some relation in origin to the norite is undeniable. The point of doubt is that they were formed by segregation by gravity from the molten norite magma. If Knight's observation is correct and if Doctor Coleman's theory of the origin of the Creighton deposit is also correct, then we must believe that an intrusion of granite roughly two miles wide and thirteen miles long was forced into the outer crust of the earth mainly along the base of the norite mass and that the Creighton orebody, already forming part of this base, was not seriously disturbed by this great intrusion. To me this is incredible. Being so constituted, I have only a choice between accepting the fact based on observation or the theory based on opinion.

Possibly, to minds differently constituted, the intrusion of granite under the enormous Creighton orebody, without seriously disturbing the latter, is easily conceivable. If so, no amount of discussion will clear the difference away.

To me there are some other serious difficulties in the way of accepting the magmatic-segregation theory as accounting for some of the larger Sudbury deposits, that I have not seen adequately met. But since I feel the keen interest that arises from more than twelve years' experience in the exploration and mining of these nickel ores, I would very much like to see further discussion and expression of opinion as to the bearing of Knight's observation on their origin. C. V. CORLESS.

Coniston, Ont., Aug. 29, 1916.

Revision of the Mining Laws

I am pleased to give a few facts that I deem essential in the revision of the mining laws of the United States. I have been a close observer of mining law and its operations ever since the early days of the Comstock Mines at Virginia, Nev.

I have been a pioneer of many mining countries, such as Idaho and the Black Hills in 1878, where I resided for over 20 years; I also spent 5 years in Alaska and old Mexico. I was graduated in metallurgy under Prof. H. C. Hoffman, who now holds a chair in the Massachusetts Institute of Technology, Boston, and I believe my experience in all these years gives me the advantage of having an opinion of my own in studying the mining laws of our own country.

The revision of the mining laws no doubt would greatly lessen the misunderstanding that now prevails. After reading the first paragraph of your article I would say, briefly, that the present law has served the miner pretty well, but in my opinion some corrections should be made and the corrections should be such as to give the prospector an advantage for his hardship in prospecting the undeveloped mineral resources of the public domain. I am glad to note that under the liberal rulings of Secretary Lane this has been accomplished in a measure. I believe that a claim staked as at present would be sufficient, but mineral-bearing rock should be discovered. Such discovery might embrace any mineral-bearing rock, whether it is talc, slate, Potsdam sandstone, quartzite or schist, which have all been known to carry gold in paying quantity in the Black Hills. To use Judge Moody's idea in deciding what constitutes a discovery, any mineral-bearing ore or vein embedded on the side of a mountain or in the formation, though it be broken up, as long as its course is downward, he considered rock in place and a valid location.

Question No. 2 I would answer, no; No. 3 I would answer, no. To No. 4, I advise location as at present. As to No. 5, locations should be made according to the trend of the vein as traceable through the ground. To No. 6, I would say that if one person be the discoverer of a mining claim, a group of, say, five claims would be sufficient; to No. 7, five claims for one group; to No. 8, yes.

As to No. 9, recording of deed of claim should be, as now, in the office of the register of deeds in the county in which the claim is located, but the law should be so framed that one person only could get a record of that particular piece of ground. Should the locator of such ground fail to comply with the United States mining law and another desired to obtain title to the ground, owing to defects in the location, an adverse decision should be brought to quiet the title. In that way it would be settled at once who is the real owner of the property.

In answer to Nos. 11 and 12, if not convenient to do the annual assessment work, the locator should have the right to pay the money in the Land Office in lieu of doing $100 worth of work; to No. 13, yes, the work should be done, if desired, on one claim, so long as it is beneficial to the whole group. To No. 14 I would say, no; to No. 15, a shaft 10 ft. deep in blasting rock should be considered an assessment for a quartz claim, or if a drift is run in a tunnel, an equal amount of work would be sufficient.

To No. 16 I would answer, yes, a record of the assessment should be made with the register of deeds of the county; to No. 17, yes, with some corrections. I have just received notice of a patent having been granted for the Copper Queen mine in Inyo County, California. I was a year and a half in getting this patent. I have no complaint to make, since my attorney omitted some items that he should have mentioned. The department at Washington, D. C., returned a letter for additional evidence. This was absolutely right, but as my home is in Denver, I procured a mining lawyer here, and he formulated the points that I was asked to correct, and I found that I was compelled to go to Inyo County, California (to the Land Office), where these claims were located, to make the additional affidavits. This was expensive, and think I should have had the right to go before any United States Commissioner to make these affidavits, and then send them to the Land Office in California, and so eliminate the red tape.

As to No. 18, the abolishing of extralateral rights should be adopted. This would greatly lessen the chances of lawsuits. As regards No. 19, record should be made as now, within 90 days from date of location. In reply to No. 20, the locator should not be compelled to patent the ground so located unless he desires to do so, and he should have full possession of the ground so long as he performs the annual assessment work. To No. 21, I would reply negatively. JAMES JACOBY.

Denver, Colo., Sept. 4, 1916.

Editorials

Copper-Refining Capacity

It is well known that the production of crude copper has increased in 1916 to a larger extent than has that of refined copper. The lag in the latter has been due to inability to increase quickly the refining capacity, which throughout the year has been taxed to the utmost. The supply of copper has in fact been checked in the refineries. We have recently made a survey of this situation.

On Jan. 1, 1916, the electrolytic refiners of the United States reported an aggregate capacity at the rate of 1,877,000,000 lb. of copper per annum, or about 156,000,000 lb. per month. Adding 20,000,000 lb. per month for the copper that is refined otherwise than electrolytically and for what is marketed as pig, we had a total capacity for the production of about 176,000,000 lb. of refined copper per month.

However, the operators of refineries are seldom able to maintain the full rated capacity for a long period. The actual production during the first half of 1916 is estimated at about 1,000,000,000 lb., or about 167,000,000 lb. per month, and that estimate is probably not far out of the way.

On Sept. 1, 1916, the refiners reported an aggregate capacity of 2,173,000,000 lb. per annum. The increase was due chiefly to the new Anaconda refinery at Great Falls, intended to replace the old one, which had been begun in 1915. At three other refineries there had been increases of capacity relatively small.

On Sept. 1, 1916, there was construction going on at four refineries, which was figured as adding about 220,000,000 lb. per annum to the capacity of the United States. This was coming along but slowly, owing to the inability to obtain prompt delivery of material and machinery. It is estimated that part of it will be ready for use in January, 1917, and part of it in February. However, at present there is no certainty respecting estimates of time.

Anyway, it is clear that no relief from the tightness in the position of refined copper is to be expected until the early part of 1917. In the meanwhile many mines producing increased quantities of copper must face the contingency of being unable to sell all of it immediately out of sheer inability to get it smelted and refined. The situation in copper is now similar to the situation in zinc in 1915, but copper-refining capacity cannot be augmented so easily and so rapidly as was the case with zinc.

The Institute Meeting

The coming meeting of the American Institute of Mining Engineers is going to be one of the most interesting that has been held in years. The visit to the great mining camps of Arizona ought to be of great benefit to every engineer, whether he is more particularly interested in mining or metallurgy. The mining methods followed at the great copper mines are varied and interesting, and many of them are novel and of recent adoption. The visits to the works of the Chino Copper Co., the Copper Queen, the Calumet & Arizona, the Old Dominion, Miami, Inspiration and Ray will constitute a wealth of uptodate mining and metallurgical experience that can probably be found in no other district of equal area in the world.

Of particular interest is the application of flotation, and many of these companies have adopted the process on a large scale and are using it successfully. The variety of methods and appliances used by the large concentrators is such as to form a liberal education for the engineer who is interested enough to make a close study of the subject. New methods of crushing and grinding are also in use at many of these mills, and the newest forms of grinding machinery are in operation. Modern and efficient methods of ore and pulp handling are installed, and ore transportation has also been so closely studied as to produce highly efficient methods. The Arizona meeting is to conclude with a visit to the Grand Cañon of Arizona on Sept. 24, where the members of the party will undoubtedly acquire some highly interesting data of a different sort. Altogether, no one who makes this trip ought to leave Arizona without having received a great amount of valuable knowledge and a strong stimulus toward future progress.

The Position of the Zinc Smelters

For some time back the price for common spelter has been seesawing between 8 and 9c. When the price has fallen to about 8c., sellers have withdrawn. When it has risen to about 9c., buyers have disappeared. At no time, however, has there been large volume of buying, and it is probable that stocks have been continuing to increase, as they began to in the first half of the year.

In previous comments upon the situation in spelter, we have drawn attention to the increased cost of smelting, owing to higher costs for labor and material and less efficiency, and we have conjectured that a market price of 7c. or so is only equivalent to about 5c. before the war. The recent behavior of the market rather bears this out. Smelters withdraw around 8c. for the reason that at that price there is not much in it for them.

Of course, at such a figure those smelters who are operating old Belgian plants in the Kansas coal field, that were abandoned around 1901 and were repaired during the war boom, find themselves in real difficulties. Similarly do those who took over old plants in the gas fields, where the supply of gas had already become short. A cost of 10 or 12c. per 1,000 cu.ft. for gas was not a matter for concern in 1915, but it is fatal now.

Therefore we now get reports of coal smelters going out of business and some of the gas smelters preparing to. This will naturally tend to bring demand and supply into equilibrium and establish the spelter market upon

a fairly stable basis, which apparently is going to be in the neighborhood of 8c. per lb. with present conditions, with a tendency, however, to work gradually lower. For one thing the production of the electrolytic works, which in some important cases has been figured—and probably correctly—as being capable of meeting the severest competition, will continue to increase. For another thing, as the ephemeral smelteries go cold, the supply of smelters will become more ample and operators, once more able to pick and choose, hire and fire, will improve the efficiency of their plants and be better able to compete at lower prices.

It is scarcely to be expected, however, that we shall see the old levels for spelter until the great readjustment in conditions for labor and material comes about, although it is likely that both miners and smelters, but especially the latter, will experience hard times before then. No one of experience in the zinc business doubts that ultimately we shall see not only 5c., but probably as low as 4c., for spelter. Some of the important new enterprises in this industry that are now in the construction stage have been projected on the basis of 4c. for spelter; that is, if they could not live at such a depth, they were deemed risky.

Facilitating Flotation

Flotation is making such advances and its application is increasing so rapidly that much study is being given to the obtaining of supplies of the ingredients necessary in its practice. It is fortunate that the requirements are few and simple, with the exception of the oil. When flotation was first applied, there was no difficulty in getting the kind of oil desired in the required quantity at a reasonable price, but since the requirements have enlarged so tremendously, the problem of securing oils has become one of vital importance. It has been found in general that petroleum or some of its byproducts will function satisfactorily so far as the oiling of the ore particles is concerned, but when it comes to the frothing agent, petroleum is seldom satisfactory. The requirement is usually for some vegetable product, such as pine oil, and the other well-known varieties that have been used in flotation practice. Some conferences between metallurgists and botanists have brought out the fact that many of the common varieties of vegetation are capable of producing oils or gums, and that it is possible to take advantage of the abundance of some particular kind of vegetation and make it produce an oil that can be used as a frothing agent.

In Australia the *eucalyptus amygdalina* supplies the frothing agent right in the territory where it is to be used. The Australians were fortunate in this, however, since the eucalyptus oil was produced before flotation was thought about. It is well known, however, that in the vegetable kingdom there are many plants whose essential oils and gums may satisfactorily replace one another. An instance of the sort is the *guayule* plant, formerly so abundant in Mexico, that was found to yield a substitute for rubber. Efforts are now being made to accomplish the same thing in flotation. The forms of vegetation most common in the localities where flotation is being principally practiced are being tested to determine their possibilities as oil producers, and it has been announced that the ubiquitous sage brush of our western country is at last about to provide a valid reason for its existence. It is said that the oil produced from sage brush will satisfactorily supply the frothing agent required by the great number of flotation plants in the West.

Antimony Supplies and Prices

The strong demand for antimony and the high prices paid for it resulted this year in a very large increase in the imports of the metal, which are the chief supply of the market. The domestic production is almost negligible, and though that has been stimulated to some extent, most of the metal smelted and refined at our works is from foreign ore. For the fiscal year ended June 30 last, the total imports into this country, including antimony contents of ore, were 32,617,318 lb., this quantity comparing with 16,090,963 lb. in 1914-15 and 13,163,629 in 1913-14. The imports of 1916 were thus more than double those of the preceding year. There were some reëxports, amounting in 1916 to 3,831,330 lb., so that the net imports for the year were 28,785,988 lb. These compare with 13,972,082 lb. net imports in 1915, an extraordinary gain.

As exports from England and France are under an embargo, the increased supply came mainly from the East, China and Japan both contributing, though China furnished much the larger share. In fact, the great demand here has built up the mining and smelting industry in that country to an extraordinary degree. The English and French brands, which formerly controlled the market here, have practically disappeared, and the current quotations are of Chinese and Japanese metal.

Not all the large net imports are retained in this country. A considerable quantity is used in the manufacture of munitions and is exported in that form. Just what the proportion is cannot be determined, since such exports are not recorded as those of antimony, but appear under other heads.

The imports of recent months have been so large that they have exceeded the demand, and prices have fallen from a high level of 45c. per lb. down to 12@12½c.; but they are still considerably above the 6 or 7c. which prevailed before the war.

There has been thus far general quiet in the labor employed in the iron and steel mills, chiefly because most of them under the intelligent leadership of the Steel Corporation have kept wages up to a pretty high level. The settlement of the threatened railroad strike, however, while it relieved immediate expectations of trouble from the steel mills, has been the cause of some apprehension to observers in the trade. What they fear is not a strike for higher wages, but a demand for an eight-hour day. This would be very embarrassing under present conditions. The greater cost of production entailed by substituting three shifts for two could be carried with prices at their present range. The difficulty would be to find the men. Labor is already scarce, and it would be impossible to get enough additional workers to carry out the change. The inevitable result would be a curtailment of production and disorganization of the trade.

In a paper recently contributed on the general problem of naval warfare, a naval officer of high rank, after discussing at considerable length and with great insight the strategy and tactics of sea conflict, makes this statement:

"Battle is first of all a contest of character; victory will come to the side which can longest sustain the will to attain it, together with the belief of ultimate success." By changing the word "battle," this becomes a perfect definition of success in mining or any other line of endeavor.

Copper producers were greatly relieved in reading the new revenue bill as finally enacted, to find that there was no reference therein to copper. The proposed tax on copper was dropped by the Senate, but it remained in the bill as passed by the House of Representatives. Therefore the matter had to be adjusted in conference. Inasmuch as this highly important measure had to be put through in the usual slap-dash way of the closing days of a session, there was a good deal of uncertainty as to what would come out. The whole business was something like drawing from a grab-bag. Copper producers were fortunate in escaping the great injustice that was proposed by the House of Representatives and owe a debt to the Senators who stood up in their behalf.

BY THE WAY

William V. Pettit, whose death was announced in the *Journal* a few weeks ago, was a well-known mining engineer, having operated in Mexico at Parral and Santa Barbara, in Chihuahua, and at Indé, Durango, between 1900 and 1908. He was born in Philadelphia in November, 1874, was graduated from Lehigh University in 1893 and was killed by shrapnel on June 29, 1916, in France or Belgium. He was a lieutenant in the Royal Engineers, of the British Army, having enlisted over a year ago. His family has received a letter from his commanding officer highly commending him as a brave and efficient officer.

A California correspondent writes us that he has seen in the papers that Jim Gillis (Mark Twain's "Truthful James") took several hundred dollars from his ground on Jackass Hill. Jim owns most of Jackass Hill. Our correspondent continues as follows: "In early days the stage road passed Jim's house, or cabin, I should say. The old miners make sourdough bread, and Jim had some in a pan trying to make it rise, but it would not, so he said, 'I'll make you rise, durn you.' He put the pan out under the oak that covered the stage road and put a stick of giant powder under it. As a result the dough hung all over the limbs of the tree. The stage came along loaded with Eastern women and 'tenderfeet,' looking for any old curiosity and about as gullible as ducks. A lady asked Jim what kind of a tree it was (Jim is a sober-faced, dry liar), and he said, 'Madam, that is a bread tree.' 'Really, is that bread we see?' 'Oh, yes,' said Jim, 'you can take it in your hands and work it into bread.' Whereupon she took some of it and believed, and told everywhere about Jim Gillis' bread tree of Jackass Hill. Old Jim is as dry as ever and an old bachelor about 65 years of age. Jim lives most of the time at a hotel in Sonora. Every Sunday he takes a crowd of women admirers to dinner, and he amuses them with his dry extravagances of early days. He keeps the whole dining room in an uproar, and many go there to eat just to hear him. Mark Twain's cabin on Jackass Hill is preserved, many going to look, for curiosity sake. Mark played poker here in Jimtown in early days in the Bella Union saloon—it is a saloon today."

The United States Metals Refining Co. has begun the publication of a "Safety First" periodical that bears the significant title of *Ax-i-dent-Ax*. As introduction, or "turning on the blast," as the editor puts it, this statement of principle is made:

"We are the friends of a man only when we expect of him and help him to express the very highest and best that is in him. We believe that a company paper, such as this, should visualize to both management and men the value, the imperative need, the possibility and inspiration in each to attain the highest efficiency.

" 'The world' says A. T. Merey, editor of *The Commonwealther,* 'has too long erroneously believed that there is attractiveness, necessity, even inevitability, in evil, laziness, carelessness, accidents, inefficiency, bad habits and ignorance. We should cultivate the art of depriving that which is wrong of all power and of showing that only that which is right and strong and lovable and safe and efficient is attractive, sane, necessary or acceptable.'

"We want to make the *Ax-i-dent-Ax* an expression of the things in the plant and the company that are spicy, breezy and newsy. There should be plenty of good wholesome humor throughout, excluding stingers or questionable personalities. Sarcasm or hits that embarass or hurt will be strictly tabooed. There is plenty of good to be said about everybody. We want to be constructive rather than destructive and thus create a dominant progressive attitude that will make our readers think."

The object is good. We wish the editors all success in their efforts to attain it.

In the event of war it is estimated that this country would need approximately 40,000 tons of nitrogen in the form of 180,000 tons of nitric acid per year. In 1915 enough bituminous coal was mined in the United States to yield, if properly treated, 1,000,000 tons of nitrogen, which could produce 3,600,000 tons of nitric acid, or, on the foregoing basis, enough for 20 years of war. Our present industrial methods of coal treatment would recover but one-fifth of this nitrogen as nitric acid, or in one year enough for four years of war, if we were properly to expand and extend these industrial methods and appliances, and also further, to convert the so-recovered ammonia into nitric acid. To make air-nitrogen now requires about $1,200 worth of plant for each ton of nitrogen recovered per year, or 60c. of plant per pound of nitrogen per year, as nitric acid. In this form nitrogen is worth about 32c. per lb. The apparatus for recovering our coal-nitrogen as ammonia and then converting it into nitric acid is not so expensive. Germany has, since the beginning of the war, increased her annual output of air-nitrates by about 100,000 tons of nitrogen, or about 2½ times our estimated war needs, but by methods far more expensive than those open to us. In view of the dormant nitrogen supplies of our coal beds and the new methods that can be used to make those supplies available to us for agricultural and industrial uses, we can all feel much easier as to our future nitrogen sources. This particular source has not had much attention before.

Progress in Porphyry Coppers

The quarterly reports of Utah Copper, Nevada Consolidated, Chino and Ray have shown great increases in copper production and also in net earnings. Utah copper shows a total production of 48,384,929 lb. of copper during the second quarter of 1916, the monthly output being 14,557,282 lb. for April, 15,950,215 lb. in May and 17,877,432 lb. in June, showing a gradual increase for each month of the quarter. The average monthly production was 16,128,309 lb.

A total of 2,758,500 tons of ore was treated at both plants, the tonnage handled and the gross output of copper being the largest for any quarter in the history of the company. The average grade of the ore milled was 1.3810% copper, and the average extraction was 63.51%. The average cost per pound of net copper produced during the quarter, after allowing for smelter deductions and crediting miscellaneous income from Utah operations only, including Bingham and Garfield Railway earnings, use 6.726c. The total net profit was $9,958,317, from which $4,873,470 was paid in dividends, leaving a net surplus of $5,084,847. The earnings were computed on the basis of 26.758c. per lb. for copper, no unsold being on hand at the end of the quarter.

The Nevada Consolidated Copper Co. for the same period produced 24,091,021 lb. of copper, the monthly production being 7,716,101 lb. in April, 7,723,148 lb. in May and 8,651,772 lb. in June. During the quarter 1,094,879 tons of Nevada Consolidated ore, averaging 1.57% copper, was milled, 88% coming from the open-pits, and 12% from underground workings of the Ruth mine. In addition, 5,084 dry tons of Giroux Consolidated Mines Co. ore was milled during the quarter. The cost of copper, including Steptoe-plant depreciation and all charges except ore extinguishment and after crediting all miscellaneous earnings, was 8.51c. per lb. The outcome is figured on a copper price of 27.23c. per lb. for the quarter, no copper available for delivery remaining unsold. The earnings amounted to $4,853,945, and after deducting dividend No. 26 and extra dividend No. 5, amounting to $1,499,593, the net surplus for the quarter remained at $3,364,352.

Chino Copper Co. produced during the second quarter of 1916 a total of 18,099,182 lb. of copper, an average monthly output of 6,033,061 lb. The monthly production was 4,496,270 lb. for April, 6,359,294 lb. for May and 7,243,618 lb. for June. In addition to the copper recovered by milling, 58,748 lb. was recovered from precipitation plants at the mine, making a total production from all sources of 18,157,923 lb.

The total amount of ore milled for three months was 788,500 tons, the average copper content of the ore treated being 1.79%. The recovery per ton of ore milled for the three months was 22.99 lb., and there was produced 62,241 tons of concentrates, averaging 14.54% copper. The cost per pound of net copper produced for the quarter, after allowing for smelter deduction and crediting all miscellaneous income, was 8.89c. The net profit and miscellaneous income amounted to $3,221,969, and dividend paid was $1,957,455, leaving a net surplus of $1,264,514. Earnings are based on 27.49c. per lb. for copper.

The Ray Consolidated Copper Co. during the second quarter of 1916 produced 18,667,664 lb. of copper, an average of 6,222,555 lb. per month. The monthly production was 6,162,117 lb. in April, 6,106,657 lb. in May and 6,398,890 lb. in June. A total of 503,574 lb. of copper in addition was contained in ore shipped direct to the smelter, making a gross total production of 19,171,238 lb. The total ore milled for the quarter was 865,300 dry tons, averaging 1.579% copper. The average net cost per lb. of all copper produced for the quarter was 10.507c. This includes a charge of 12½c. per ton of ore milled, for the retirement of mine-development cost, but is after crediting dividends of the Ray & Gila Valley R.R., revenues from gold and silver produced, and other miscellaneous incomes. Earnings are based on a price of 28.067c. per lb. for copper. The total net operating profit, including miscellaneous income, amounted to $3,242,542, from which a dividend of $788,589 was paid, leaving a net surplus over dividend requirement of $2,453,953.

In these reports it is shown that all records were broken for copper production which, under the stimulus of high prices, resulted in the maximum endeavor being directed toward metal output. The high output for the second quarter was remarkable in itself, but the prospect of these companies was even more remarkable, since it was expected that even greater production would be accomplished. That this prophecy was well founded is shown in the July output, which for the four companies mentioned amounted to 42,557,354 lb. of direct production, as against 40,171,612 lb. of direct production for June. Both the Utah and Ray again broke their records in July. The production for the four companies was: For Utah, 20,302,228 lb.; for Nevada Consolidated, 8,537,231 lb.; for Chino, 6,883,403 lb.; and for Ray, 6,834,492 lb.

Frank McMillan Stanton

Frank McMillan Stanton died in New York, Sept. 11, aged 51 years. Practically all his life identified with the Lake Superior copper country, he was one of the best-known operators in that region and was recognized as an able successor of his father. He was a son of John Stanton, so widely known as one of the chief representatives of the copper industry in this country. His mother was Elizabeth R. McMillan, of an old New York family. He was born in New York in 1865 and was brought up in the public schools of the city and in the School of Mines of Columbia University, from which he graduated in 1887. For about two years he worked as a mine surveyor and assayer and then decided to embark in the mining field on his own account, which he did successfully. Soon after, he was offered a position with the Atlantic Mining Co., of which his father was president, and in a short time rose to the position of superintendent, which he held for over 20 years. His work with the Atlantic was hard, as is well known. The mine was one of the lowest-grade exploitations in the Lake Superior region, and the closest economy and most careful work were needed to make it pay. This was attained under the management of Mr. Stanton and his father, and for years the company was able to pay dividends on a copper recovery that many engineers would have regarded as entirely insufficient. The mine held the record for low cost of production for many years and has probably never been surpassed for close and careful management. While engaged in this work Mr. Stanton was called upon

to act in an advisory capacity to several other mines, among them the Wolverine and Mohawk.

He retired as superintendent of the Atlantic in 1910 on account of ill health and went to Europe for a rest, visiting many Continental countries and inspecting a number of mines. He remained abroad for about three years, returning in excellent health, and in 1914 was made treasurer of the Wolverine and Mohawk mining companies, to which were afterward added the Michigan and the White Pine Extension companies, all of them being under his active supervision. The Wolverine especially was a marked contrast to the old Atlantic, its property including some of the richest lodes in the region. Mr. Stanton's knowledge of mining methods and also of market conditions were apparent in the management of the newer companies. He was also directly interested in the management of the Michigan Smelting Co., which treated the output of his several copper companies, being a director of that company from its formation.

Outside of his copper properties, Mr. Stanton was president of the Fort Mountain Talc Co. in Georgia, which was a successful enterprise. He was a director of the Ohio & Kentucky R.R., which penetrates the Kentucky coal region, and was also interested in the Copper Range Co., which opened mines on the south range in the Lake Superior country. In addition to his commercial interests, he was very active in social and professional life. He was a member of the American Institute of Mining Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Chemical Society, the Lake Superior Mining Institute and many other technical societies. He took an active part in the present movement for national preparedness. He was also a member of many clubs and social organizations. He residence, which for many years was in Houghton, Mich., had been in recent years in New York City, and he also owned a summer home at Whitestone on the north shore of Long Island.

No one else, except perhaps his father and his brother, John R. Stanton, has been better known or more closely identified with mining in the Lake Superior country than was Frank M. Stanton, and he will be widely missed.

Copper in the Far North

Seven members of Dr. R. M. Anderson's party, southern branch of the Stefansson Canadian expedition into the far North, arrived in Seattle, Wash., a few days ago, whence they will leave soon for Ottawa, to make their report to the Canadian Government. According to the New York *Evening Post,* Sept. 12, 1916, Dr. Anderson said:

We were instructed to survey the copper deposits already known and seek new ones. Every explorer from the earliest times has noted that the Eskimos east of the Mackenzie used knives, spearheads, and other weapons and utensils hammered from copper, and the Coppermine River, which empties into the Arctic, got its name from mineral discovered many years ago. We found on Coronation Gulf and Bathurst Inlet vast deposits of copper ore of low grade. We were not equipped to undertake mining operations, but upon the sides of cliffs we could measure the depth of successive flows of amygdaloidal lava containing native copper. An Eskimo brought to us a lump of copper weighing 40 lb. There were seams in the lava that had been filled with pure copper. Our geologist, Mr. O'Neill, took many samples of rock, which will be assayed. He also made many estimates of the area of ore in sight. This information is for the Canadian government and is not to be published by us.

The ore had many of the characteristics of the Lake Superior copper rock. It is workable from the surface and is near navigable water. It would be feasible to construct a railroad from the Mackenzie River, which is navigable five months of the year, to Great Bear Lake, which also is navigable much of the year. A further railroad line could be built from the lake to the copper fields, enabling the transportation of the ore to the interior of Canada by way of the Mackenzie River.

Our headquarters were on the south side of Dolphin and Union Straits, which run out of the west end of the Coronation Gulf. We took from our vessels enough lumber to build a house. Along the beaches we found nearly enough small driftwood to keep us in fuel, but we also used coal that we took north with us. There is workable coal within 10 miles of Franklin Bay, on the Arctic. This coal outcrops in ravines, veins several feet thick having been found.

NEW PATENTS

United States patent specifications listed below may be obtained from the "Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ACIDS—Process of Making Mineral Acids. Henry Howard, Brookline, Mass. (U. S. No. 1,193,552; Aug. 8, 1916.)

AGGLOMERATING—Process of Agglomerating Finely Divided Granular or Friable Materials. Adolphe Victor Marie Kroll, Luxemburg. (U. S. No. 1,196,705; Aug. 29, 1916.)

ALUMINOUS PIGMENT and Paint. Oscar Warren Pickering, Springfield, Mass., assignor to Pickering Paint & Pigment Co. (U. S. No. 1,195,604; Aug. 22, 1916.)

ALUMINUM—Composition of Matter to be Used for the Welding and Soldering of Different Articles Constructed of Aluminum Only. Robert Lee Weatherford, Fort Worth, Tex. (U. S. No. 1,194,101; Aug. 8, 1916.)

BLAST-FURNACE TOP. William H. Bailey, Gary, Ind. (U. S. No. 1,193,750; Aug. 8, 1916.)

BLASTING—Method of Channeling and Severing by Blasting. Tere A. Clark, Chicago, Ill. (U. S. No. 1,195,781; Aug. 22, 1916.)

CHARGING APPARATUS—Improvements in Transporting Apparatus, more Especially Intended for Charging Articles into Furnaces and Withdrawing Them Therefrom. Wellman, Seaver & Head, Ltd., and F. G. Smith, London, England. (Brit. No. 19,597 of 1914.)

CLASSIFYING—Process of and Apparatus for Sizing or Classifying Comminuted Material. Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Tex. (U. S. Nos. 1,196,047 and 1,196,048; Aug. 29, 1916.)

CONCENTRATING TABLE. George Petrie Sandie, Thessalon, Ont. (U. S. No. 1,196,295; Aug. 29, 1916.)

DRILL—Pump Drill. George H. Gilman, Claremont, N. H., assignor, by mesne assignments, to Sullivan Machinery Co., Boston, Mass. (U. S. No. 1,195,350; Aug. 22, 1916.)

DRILL—Rock Drill. Moses Arthur Knapp, Oakland, Calif. (U. S. No. 1,195,478; Aug. 22, 1916.

DRILL—Rock Drill. Niels C. Mickelson, Denver, Colo., assignor to The Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,196,011; Aug. 29, 1916.)

DRILL BITS—Rock-Drill Bits and Chucks. F. C. Macdonald, San Francisco, Calif. (Brit. No. 2,473 of 1915.)

DRILLING—Improvements in Rock-Drilling and Other Pneumatic and Like Tools. J. H. A. Macadam, Johannesburg, So. Africa, and J. Thirlwell, Anston, Transvaal, So. Afr. (Brit. No. 2,779 of 1915.)

DRILLING—Rock-Drilling Apparatus. William A. Smith, Denver, Colo., assignor to The Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,196,041 and 605; Aug. 29, 1916.)

DRILLS—Rotating Means for Drills. Daniel S. Waugh, Denver, Colo., assignor to The Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,196,052; Aug. 29, 1916.)

ELECTRIC SMELTING—Apparatus for Preventing Sintering in Electric Furnaces. Edward Salmon Berglund, Trollhättan, Sweden. (U. S. No. 1,196,202; Aug. 29, 1916.)

ELECTRIC SMELTING—Process of Securing Metal from Ores. James Henry Reid, Newark, N. J. (U. S. No. 1,195,607; Aug. 22, 1916.)

FUMES—Apparatus for Utilizing the Heated Fumes from a Smelter or Ore Furnace. Gustav P. Luedke, Chatham, Ill. (U. S. No. 1,196,123; Aug. 29, 1916.)

PERSONALS

Charles W. Johnston is now at Portsmouth, Va.

T. L. Lee recently in New York is now at Shanghai, China.

J. M. McClintock has gone from Altadena, Calif., to Oxford, Ohio.

Ray B. Anderson, recently in New York, is now at Soldier Summit, Utah.

Charles A. Randolph, lately in Cuba, is now at Kirkland Lake, Ontario.

H. L. Mead is now at Trinity Center, Calif. He was recently in New York.

George Watkin Evans, Seattle, Wash., is in the interior of Alaska on professional business.

J. M. Lovejoy has joined the staff of geologists of the Producers' Oil Co., Billings, Montana.

Edward J. Montonlieu recently at the United States Mint in Philadelphia is now at Havana, Cuba.

H. P. Prather, recently at Section 30 mine on the Vermilion Range in Minnesota, is now at Cleveland, Ohio.

Robert S. Lewis, formerly at Stanford University in California, is now at the University of Utah at Salt Lake City.

James R. Stack is now with the American Smelting and Refining Co. at Maurer, N. J. He was recently at Baltimore.

H. P. Sweeney formerly at Stroudsburg, Penn., is now superintendent of the Fort Montgomery Iron Co., Fort Montgomery, N. Y.

Nelson Dickerman has left San Francisco on an examination trip in Bolivia and Chile. He expects to be back about the first of December.

Francis Church Lincoln, director of the Mackay School of Mines, Reno, Nev., recently returned from Bolivia where he had been for several months.

Paul O. Wels is at La Fundicion, Peru, where he has erected a concentrator for the Cerro de Pasco Mining Co. to test their ores by gravity methods and flotation.

P. J. Freeman has resigned from the professorship of applied mechanics in Kansas State College to become engineer of tests for the Pittsburgh Testing Laboratory.

Adolph G. Carlson, mechanical engineer since 1907 and formerly superintendent of the Sandusky Portland Cement Co., is appointed chief engineer of the Universal Portland Cement Co.

Pope Yeatman and **Edwin S. Berry** announce that they have opened offices at 111 Broadway, New York, Suite 1108-1110, and will take up independent work as consulting mining engineers.

Henry G. Ferguson, of the U. S. Geological Survey, of Washington, D. C., is in the Mogollon, N. M., camp gathering material for a geological folio and other complete data of the district.

G. K. Painter, chief metallurgist of the General Chemical Co., and the Nichols Copper Co., New York, and **W. E. Hill,** general manager of the Pulaski Copper Co., of Virginia, have been inspecting the copper deposits at Mine Center, Ontario.

Hon. A. B. Hudson and **Hugh McNair,** of the Public Utilities department of Manitoba, and **J. A. Campbell,** commissioner for Northern Manitoba, have gone to make a survey of the resources of the territory extending from The Pas to Hudson Bay.

Capt. J. B. Hodgson, former mine inspector of the Copper Queen mines at Bisbee, Ariz., has accepted a position on the consulting staff of the Phelps-Dodge corporation. His time will be divided between the various properties of that company in an advisory capacity.

Frank H. Sistermans, mining engineer of El Paso, Tex., has returned from a business trip to northern Mexico and will again leave for Arizona shortly to investigate several mining propositions for eastern clients. He expects to be back in El Paso in about three or four weeks.

Charles A. Randall has resigned his position as mill superintendent with the Tough Oakes Gold Mines, Ltd., to accept a position with Messrs. Simonds & Burns, mining engineers of New York, in the capacity of superintendent of construction and operation of two cyanide plants in Cuba.

OBITUARY

J. Bruce Wallace mining engineer at the Reeder mine, near Bessemer, Ala., was killed in the mine Aug. 26 by a fall of rock. He was 35 years old and lived at Birmingham, Ala. He had been at the Reeder mine for three years.

Judge D. C. Beaman, a former vice-president and one of the organizers of the Colorado Fuel and Iron Co., died in Denver, Sept. 8, aged 77 years. He was widely known as a lawyer and sportsman, being one of the organizers and a former president of the American Trotters' Association. Judge Beaman was a friend of John D. Rockefeller, and assisted John C. Osgood in forming the Colorado Fuel and Iron Co., with which he served for 25 years, retiring in 1910 when general attorney. He was a veteran of the civil war. Judge Beaman left a widow, three sons and a daughter.

Charles S. Prosser, head of the department of geology in the Ohio State University at Columbus, was found dead Sept. 12, in the Olentaugy River. He was 50 years old. Professor Prosser was a graduate of Cornell University, and before going to Ohio was instructor at Cornell, Washburn College, Topeka, Kan., and at Union College. He was the author of more than a dozen books on geology and was a Fellow in the Geological Society of America. He had many relatives in New York. Professor Prosser was an assistant geologist of the United States Geological Survey and of the State Geological Surveys of Kansas, New York, Ohio and Maryland.

SOCIETIES

American Iron and Steel Institute—The eleventh general meeting will be held at St. Louis on Friday and Saturday, Oct. 27 and 28. This will be the first meeting of the Institute west of the Mississippi, and a large attendance is anticipated.

Colorado School of Mines—George J. Young, formerly of the University of Nevada and of the University of Minnesota, is the new head of the Metallurgical Department; while Claude E. Van Nuye will head the Physics Department. A new department of English and Foreign Languages will be under Prof. Carrol G. Dolman. The college year began Sept. 5, with a large attendance.

Colorado Scientific Society, at its meeting, Sept. 2, discussed the subject of "Smoke Abatement," the speakers being Henry Read, chairman of the Denver Art Commission; Dr. J. A. Amesse, Lewis B. Skinner, superintendent of the Western Chemical Mfg. Co.; and Edward A. West, chief engineer of the Denver Tramway Co. The subject was handled with special emphasis on the local Denver conditions.

National Safety Council—The annual meeting will be held at the Hotel Statler, Detroit, Mich., Tuesday, Oct. 17, with the opening session at 10 a.m. The third annual report of the secretary, W. H. Cameron, which will be presented at that time, devotes itself in part to the record for the year 1915-16. The council started work in October, 1913, with $1,400 and 40 members. At the end of June, 1914, there were 731 members and at the end of the second fiscal year 1,211 members. The present membership is 2,120, with over 10,000 representatives and 3,500,000 employees.

Iron and Steel Institute—The autumn meeting will be held in London Sept. 21 and 22, at the building of the Institution of Civil Engineers, Great George St., Westminster. The following is the list of papers that are expected to be submitted for reading and discussion:

1. H. Brearley: "Some Properties of Ingots."
2. Prof. E. D. Campbell: "Influence of Heat-Treatment on the Thermo-Electric Properties and Specific Resistance or Carbon Steels."
3. Dr. H. M. Howe and A. G. Levy: "Heat Treatment of Eutectoid Carbon Steels."
4. J. N. Kilby: "Steel Ingot Defects."
5. Herbert K. Scott: "Manganese Ores of the Bukowina, Austria."
6. Dr. J. E. Stead: "Influence of Elements on the Properties of Steel."
7. Dr. J. E. Stead: "Notes on (a) Nickel Steel Scale. (b) On the Reduction of Solid Nickel and Copper Oxides by Solid Iron. (c) On Effect of Blast Furnace Gases on Wrought Iron."
8. G. F. Zimmer: "Use of Meteoric Iron by Primitive Man."

Editorial Correspondence

SAN FRANCISCO—Sept. 6

The Coast Oil Fields are attracting attention and more interest is being shown in oil development, according to State Mining Bureau reports, than at any time during the last three or four years, especially in drilling in outlying districts. Several wildcat wells are being drilled in the Santa Maria, Ventura and Los Angeles regions. There is little or no indication of such rash and ill-timed boom conditions as existed several years ago leading to overproduction and wasted money. Reports received by the bureau show 7 new wells started during the week ended Aug. 19, making a total of 463 since the first of the year. Twenty wells are reported for test of water shutoff, four for deepening or redrilling and two for abandonment.

Trinity County Dredging Field is receiving much attention this year. Prospecting is being actively conducted with churn drills and shafts on a number of streams and construction of several dredges is under way. On Coffee Creek, the hull of the 9 cu.ft. steel dredge of the Pacific Gold Dredging Co., has been completed, and is expected to be in active operation before winter. The dredge is being constructed under difficulties, as every plate, bolt, and piece of machinery, to say nothing of the supplies for a large camp, have to be hauled 60 mi. by mule-team over a mountain road. The company has about 300 head of stock in service, and over 30 wagons on the road. Recently, wagons transporting the tumbler went over the bank, dropping a steep 130 ft. down the gulch and carrying with them 14 mules and the driver. Fortunately the driver and mules escaped injury, but the two wagons carrying the load were badly wrecked. The dredge hull is 163½ ft. long and 63 ft. wide. Three drills are in constant operation testing the ground in the path of the dredge. They are putting down an average of one hole every two days to a depth of from 40 to 50 ft.

First-Aid and Mine-Rescue Contests at the California State Fair on Sept. 6 attracted a large number of visitors who had never seen a similar demonstration. Some of the spectators believed it was a motion-picture show, alternating with the horse races, the polo exhibition, trapeze stunts and airship demonstrations. So they were at least pleased in the way that one is pleased with variety in vaudeville. Occasional doubts were expressed whether the men were real miners. The small attendance of mine owners and miners who should be vitally interested in the contests was no doubt largely due to the destruction of the exhibit pavilion by fire on Sept. 2. The mining and most of the other exhibits were housed in this building and nothing was saved. Many visitors from the mining counties who might have been attracted to the mining exhibits did not visit the fair. The California Metal Producers Association, under whose auspices the contests were given and the State Industrial Accident Commission, assisting, were largely represented. The first-aid prizes went to teams of the Kennedy Mining and Milling Co. of Amador County; Empire Mines, of Nevada County, Argonaut Mining Co., of Amador County. Their scores were 99.7, 99.2, 97.2 respectively. There were 9 teams in the contest. In the one-man event the Empire Mines team won with a score of 100; in the two-men event the Mammonth Copper Mining Co. team won with a score of 100. The mine-rescue contest was between the following teams, named in the order of the results. Empire Mines, 89.4; Mammoth Copper Mining Co., 88.4; North Star Mines, 74.8. This is the second annual field meet for California miners conducted by the California Metal Producers Association and the State Industrial Accident Commission. The men showed commendable improvement.

The Moral Cleanup of Keeler, Inyo County, in the past week was a lesson to the lawless element that has dominated the camp ever since the Cerro Gordo and other mines have resumed profitable operation. In this section the Inyo Development Co. and the Natural Soda Products Co. have been increasing the output of Owens Lake products and the Saline Valley Salt Co. has been active. The industrial, law-abiding men of the district, having learned that prohibition does not prohibit and that dry towns are often worse than wet, concluded to get rid of the liquor-drinking element as the best means of dealing with the dealers in intoxicants. Things had reached such a condition that an honest man's life was not safe and the vigilantes started in to make a cleanup. It was done without the aid of the sheriff and it did not cost Inyo County a dime. They are a peculiar people in that region, and this is not the first time in the last 10 years that bloodless and inexpensive battles have been won by the law-and-order men who are opposed to paying taxes for unnecessary police protection. During the Western Federation strike at Goldfield several years ago, the effort to shut off the water supply and electric light and power, that have their source in Inyo County, was frustrated by the vigilantes of Bishop. Keeler has now saved itself and the Owens Lake region from a possible reign of terror and bloodshed. To the south, Randsburg is "dry," and in its dry state there has been just an intimation of peevishness on the part of the bad element. But if necessary Randsburg, Johannesburg, Atolia and Trona will soon get together and clean up their part of the desert.

BUTTE—Sept. 7

Butte's August Payroll is close to the $3,000,000 mark; with the average price of copper for the month of August at 26.12c. per lb., the August wage scale of the Butte mining companies will be increased 25c. per day over the previous months' scale, probably making the August roll the largest in the history of the Butte district. The Anaconda company alone will distribute $1,630,000 in wages to Butte employees. To this should be added the smelter payrolls of $606,400 at the Washoe works in Anaconda and of $280,750 at the Great Falls reduction works. Other Butte mining companies will distribute approximately $700,000 in August wages. East Butte pays about $130,000; North Butte $165,000; Butte & Superior $230,000 and the balance by Elm Orlu, Timber Butte, Davis-Daly, Pilot Butte, Tuolumne and others. Counting in the Washoe and Great Falls plants, the total payroll for the mining industry alone in the Butte district will be $3,250,000. Payrolls in other lines of business in Butte will swell this to a total of $3,750,000.

SALT LAKE CITY—Sept. 8

Sulphuric Acid Plant of the Garfield Chemical and Manufacturing Co. at Garfield is approaching completion. It is expected to have the plant in operation well ahead of Utah Copper's leaching plant, for which it is to supply sulphuric acid. There has been considerable delay in getting together materials, owing to the unusual activity at manufacturing plants furnishing these. The chemically treated bricks for the chambers are now coming and the chambers will soon be finished. It is expected to have the entire plant ready for operation by the end of October, or early in November.

An Unusual Number of Mineral Surveys were asked for in the year ended June 30, 1916, according to the report of the surveyor general of the Land Office at Salt Lake City. These mining surveys reflect the increased activity both in mining and prospecting. The recent reduction made by the office in the advance fee for office work on such surveys (now $20, formerly $30 per location) may also have had its effect. Better and more economical methods of work have made possible the reduction, the average actual cost per location having been for the first half of year $18.50, and for the latter half, $15,90 per location. For such work the office received a total of $3,988 during the year as compared to $6,396 during the year preceding.

Stockholders of Ohio Copper are making an effort to get together with a view to looking after their interest in the property. A stockholders' protective committee is being formed, and a plan and agreement of reorganization is in preparation. Owners of stock are asked to send their names and addresses, with the number of shares held, etc., to the International & Intercontinental Mining and Refining Corporation, at 60 Wall St., New York. A statement to stockholders by this corporation, following the sale of the properties, advises that although a judgment to the sum of $1,432,000 was obtained, properties were bid in by the bondholders for $750,000; and declares it to be manifestly the purpose of the bondholders through a deficiency judgment to secure the stockholders' right of redemption, the loss of which would render the stock valueless. The International & Intercontinental Mining and Refining Corporation goes on to say that, in its own interest, as a stockholder and in conjunction with other stockholders it has caused a suit to be instituted and a "lis pendens" to be filled in Utah; and has secured a stay in

the United States court, so that the stockholders may have an opportunity to consider a plan to preserve their rights, stating that apparently no effort was made by the officers and directors of the Ohio Copper Mining Co. to call stockholders together to protect their interest at the sale or to advise them of the fact that during the receivership the property has been in profitable operation under a lease yielding a revenue in aggregate sufficient to liquidate all debts of the company including interest on the bonds—there being $369,000 cash on hand, largely from this lease, and demonstrating that the property is capable of earning many times the interest on the $1,142,000 outstanding bonds. On the other hand there has been talk of a $2 assessment on stockholders to release the company from bankruptcy and return the property to the shareholders. It has been stated that the bondholders protective committee, to prevent the stockholders from redeeming the property within six months after the foreclosure sale, as provided by the Utah statutes, offered $40,000 for this right and the bid was accepted by the trustees in bankruptcy. These matters will be discussed at a stockholders meeting on Sept. 15 at Room 1808, 43 Exchange Place, New York. An extension of the lease on the property has been granted for three months from Sept. 1 to Dec. 1 to the General Exploration Co. at present operating the property. This extension has been approved by Judge Ritchie and the receivers, H. G. Catrow and C. T. Lark, have been allowed $35,000 for work and expenses.

HOUGHTON, MICH.—Sept. 9

Isle Royale's Increased Tonnage is worthy of note. It has been gradually increasing "rock" tonnage, and maintaining copper content. This month the ore output will be close to 80,000 tons. When this is compared with 57,000 tons monthly for last year it will be seen that the astonishing results that are coming to notice at this property warrant the increasing interest that is being taken in some quarters. Isle Royale is working out its salvation in the one way possible—substantial increase in tonnage.

Ahmeek, in the Kearsage Conglomerate, has cut 28 ft. of good looking copper rock. Two crews are drifting north and south but it will be several weeks before the worth of this strike will be known; there is hope that it will be another asset of merit to the Ahmeek property, now so well opened on the Kearsarge amygdaloid in its richest zone. The Kearsarge conglomerate has never been found at any point attacked to have commercial value. In the early days it was opened on what was then known as the original Kearsarge mine, now a part of the North Kearsarge branch of the Osceola Consolidated company. The showing of copper, however, petered out before any substantial depth was attained. Back in the early days when the late John Hodgson was superintendent and Frank Kleptko, then a recently graduated mining engineer, were working for the Bigelow interests they opened on the old Ahmeek property two small shafts on the Kearsarge conglomerate, one to a depth of 300 ft. and the other to a depth of 460 ft. Some of the stockpile from these shafts can be seen from the highway and street-car tracks at Ahmeek now. Work was discontinued when the situation looked promising, the Ahmeek being out of funds and financial conditions not warranting a resumption. When the Ahmeek did resume it was on the Kearsarge amygdaloid, then of proved value at so many other properties in that vicinity. Some time after this, samples were made of the stockpiles from the old shafts on the conglomerate and these ran so high in copper that the stockpiles were sent to the stamp mills. Following diamond-drilling results, the present management decided recently to make an examination of the conglomerate from No. 2 shaft. A crosscut was run straight to the west a distance of 1,300 ft. where the Kearsarge conglomerate was cut last week at a depth of 1,500 ft. from surface. There is a great deal of interest in the discovery here as it is quite within the range of possibilities that the Kearsarge conglomerate may add another mine to the present rich mine of the Ahmeek.

JOPLIN—Sept. 9

At Conway, an Old-Time Mining Boom is in progress. This new camp is about midway between Wentworth and Ritchey. Numerous good shallow strikes have been made there recently and 100 operators from Joplin have gone there to try their luck. Ore is found as shallow as 12 ft. and down to as deep as 150 ft.

The Oklahoma Zinc Field has attracted another large Joplin operator. During the last week S. Y. Ramage & Son acquired a lease and half interest in the fee of a 200-acre tract of land immediately adjoining that on which the Picher company is operating at Picher, Okla. Announcement is made that the Ramages will do 10,000 ft. of drilling at once. The Ramage sheet-ground mine in the West Joplin camp is closed, awaiting better ore prices.

Smaller Smelters Are Closing their plants as a result of the poor demand for spelter. The American Spelter Co., the Lanyon Smelting Co., and the Bruce Smelting Co. have all closed their plants within the last two weeks. Six of the eight furnaces of the Pittsburg Zinc Co. are down, and it is understood that the furnaces of the Joplin Ore and Spelter Co. and of the Weir Smelting Co. will be closed as soon as their present supply of ore is exhausted, unless spelter prices become stronger. The Fort Smith Spelter Co. recently contracted for 500 tons of calamine weekly from the Arkansas fields, mostly from Rush, and Manager H. S. Buck declares his plant can operate under low spelter prices, owing to advantageous contracts for natural gas from the new Kibler field.

TORONTO—Sept. 9

Nickel Refineries of the International Nickel Co. and the British Canadian Nickel Co. may both be erected in southern Ontario, as climatic conditions will prevent their placing the plants as far north as the mines. Many localities have endeavored to secure these industries, but the representatives of both companies after full investigation have decided that the severity of the climate during the winter would prevent their selecting a site even in the latitude of Ottawa where they were offered favorable terms, though that is considerably farther south than the mining region. The International Nickel Co. has definitely decided on a site at Port Colborne and has let the contract for construction of the works to the Foundation Co. of Montreal and New York.

The Cobalt Wage Situation is under consideration by a royal commission now sitting in Cobalt hearing evidence regarding the contention of the men that on account of the high cost of living they should receive higher wages. The men are also trying to force the operators to recognize the union. The operators while quite ready to receive committees of their own employees, or of a purely local organization, absolutely refuse to recognize a committee representing the Western Federation of Miners. Last May, the operators, recognizing that there was some unrest among the men on account of the higher cost of living, voluntarily decided to raise wages among all underground men, 25c. a day. In a number of cases surface men were also raised the same amount. A bonus of 25c. a day was also promised to underground men when silver sold for an average of 70c. an ounce for the month. The present scale of wages in Cobalt which is equal to the highest paid in eastern Canada, is $3.50 per 8-hr. day for drill runners, $3.25 for helpers, $2.75 for muckers, and $2.25 and $2.50 for surface labor with only a few men receiving the $2.25 wage. The men are not satisfied with this, however, and want a minimum of $2.75 for surface men and $3.75 for drill runners, with all other men receiving a 25c. increase over the present scale. The men refer to the high cost of living but forget to take into consideration the high cost of mining. Cobalt has paid higher wages for a longer period than any other camp in eastern Canada. In 1907 when there were practically no camps paying over $2 for drill runners, Cobalt was paying $3.25, with other men in proportion, and the increase granted in May puts Cobalt miners on a par with the other camps in northern Ontario which pay the highest wages in eastern Canada. There has also been a decided falling off in the efficiency of labor during the past two years. A large number of the most physically fit men have gone to the front and their places have been filled by a much inferior class of men. The shortage of labor has also contributed to the decline in efficiency and a dollar paid in wages brings a much smaller return in work than it did two years ago. Cobalt is a declining camp, the high point of profit and the value of the output having been reached in 1912. This decline will be a constant one till the end of the mines is reached. A much greater tonnage of ore now has to be treated to get a smaller profit. Some of the mines are so close to the point where operations are unprofitable that a further raise in wages would be a serious matter. While the miners are advancing the argument that the high cost of living is the reason for the request for more wages, the real reason is that they are attempting to take advantage of the labor shortage arising out of the war. The operators believe in paying wages on which the men can live well, and think they are paying this wage. They also believe they are paying high wages for the class of labor they are getting. There was no valid reason for appointing a royal commission which was simply a political move in view of a possible election. Politics being mixed up in the case is likely to result in a finding somewhat unfavorable to the operators. It is a foregone conclusion however that the operators will refuse to make a further raise in wages or to recognize the Western Federation, and in the rather unlikely event of a strike they will simply close down the mines until such time as the war is over when they will be able to offer positions to the men coming back from the front and in this way help to solve what will be a considerable problem in itself.

The Mining News

ALABAMA

Blount County

ONEONTA ORE AND MINING (Oneonta)—Newly organized company in Red Mountain district. Shipping about 100 tons daily. Several new openings being made in mountain side. Ore hauled by teams at present.

ALASKA

ALASKA-GASTINEAU (Juneau)—Milled in August, 169,100 tons; calculated heads, $1.38; extraction, 81.51%; tails, 25c. In July milled 150,403 tons; average value $1.24. In first 10 days of September, milled 50,510 dry tons; calculated heads, $1.51; extraction 82.65%.

ARIZONA

Cochise County

SHATTUCK-ARIZONA (Bisbee)—August copper output was 1,699,575 lb.; July production 1,397,445 lb.

Gila County

OLD DOMINION (Globe)—August copper production 3,600,000 lb.; July production 3,852,000 lb.

INSPIRATION (Miami)—August estimated production 11,450,000 lb. copper, as against 11,300,000 lb. in July.

MIAMI (Miami)—New high record made in August; output 4,698,795 lb. copper. Previous high was in May when 4,596,300 lb. were produced.

ARIZONA COMMERCIAL (Globe)—Mining of the new vein on the 1,200 level is under way, little water having been encountered. Crosscut on the 1,400 is in solid sulphide ore, said to assay 10% Cu.

Greenlee County

ARIZONA COPPER (Clifton)—Estimated August production, 4,800,000 lb.

Mohave County

FESSENDEN (Oatman)—Development is to be resumed about Sept. 15.

BOUNDARY CONE (Oatman)—Drift on 750-ft. level still in milling ore.

SUN DIAL (Oatman)—Hoist and compressor installed and sinking is in progress.

JEROME-OATMAN (Oatman)—Incline shaft down 400 ft. B. P. Delahanty in charge.

IVANHOE (Oatman)—Shutdown necessary pending arrangements to pump about 26,000 gal. daily.

TOM REED (Oatman)—Stoping in big shoot on 1,400 level. Sinking winze to the 1,700. Black Eagle ore developments continue satisfactory.

UNITED EASTERN (Oatman)—Raising from depth of 690 ft. under No. 2 shaft and sinking from the 590-ft. point, which corresponds to 465 ft. in No. 1 shaft. At the new mill, two ball mills are in place and two tube mills have been received; chrome-steel balls will be used instead of pebbles.

Yavapai County

BIG LEDGE COPPER DEVELOPMENT (Mayer)—This company, which is developing the Henrietta and Butternut mines, has leased the old smelting plant at this place and has engaged A. C. Cole to rehabilitate the plant.

CALIFORNIA

Amador County

KEYSTONE (Sutter Creek)—Station being opened at 1,300 level to search for orebody known to exist below the 1,400 level. Since Keystone Mines Co. has been operating (about 4 years), main shaft has been deepened 1,000 ft. Mill operating regularly. C. R. Downes, superintendent.

CONSOLIDATED AMADOR (Sutter Creek)—Unwatering and repairing of shaft has reached 600-ft. point; recent work slightly retarded by small caves that had to be caught up as timbering progressed. Temporary sinking pump to be installed at this level. T. Walter Beam, manager.

Butte County

YANKEE (Oroville)—Placer on Berry Creek purchased by B. J. Carr, of Alameda. Will be worked on small scale.

ORO ELECTRIC (Oroville)—Prospecting of dredging ground in Thermalito district in progress. Installation of steel-hull dredge contemplated by American Dredging Co. which has taken over dredging interests of the Oro Water Light and Power Co. Company expects also to develop dredging ground in Shasta County and is building a new dredge in Calaveras County. R. L. van der Naillen, manager.

Calaveras County

MAYPOLE (Mokelumne Hill)—Cleaning out old tunnel; badly caved. Recent prospecting disclosed a $2,000 pocket.

Eldorado County

MOUNT PLEASANT CONSOLIDATED (Placerville)—Operation by New York men contemplated as soon as reorganization is completed. Property has 1,100-ft. shaft. F. C. Van Schaick, president.

Madera County

MADERA GOLD MINING CO. (Madera)—Permitted to issue 150,000 shares of common stock to D. W. Shank and A. W. Copp in exchange for option to purchase properties and to sell 150,000 shares of preferred stock. Company is taking over the idle Josephine and Gambetto mines in Madera County on lease and option to purchase for $60,000. Expect to install electrical equipment and to unwater old shaft.

Nevada County

BRUNSWICK (Grass Valley)—Main shaft down 1,200 ft. vertically. New drum installed on hoist to permit deeper development.

PHOENIX (Nevada City)—Drift mine may reopen in September, under management of Andrew Goering. Closed a month ago account large hard boulders being encountered. Developed by tunnel 980 ft. long.

E. W. KAY AND F. A. ELLIOTT may divert Yuba River channel below Humbug Cañon. Tests indicate pay gravel in river bed. Same men will reopen lode mine at Round Mountain; advancing 500-ft. tunnel 100 ft.

CALIFORNIA MINING CO. (Grass Valley)—Formal transfer of property under bond to King C. Gillette, safety-razor man. Purchase price said to be $80,000, to be made in 3 annual installments. New machinery and building will be installed. Property situated in Rough and Ready district.

GRASS VALLEY CONSOLIDATED (Grass Valley)—Buildings being prepared for hoist, due in September, for the Allison Ranch property. About 600 ft. of drain boxes have been constructed to handle waste water. Ditch line extends from the North Star and has capacity of 260 in. of water; to be used for compressor and emergency hoist.

Plumas County

CHROME ORE being hauled from Onion Valley to Quincy by three motor trucks. Deposits also being worked at Claremont, south of Quincy.

OVERSIGHT (Quincy)—Good milling ore disclosed in 6-ft. vein in this property on Washington Creek.

POORMAN CREEK (Quincy)—Reported that hydraulic plant is to be installed and reservoir enlarged.

Tuolumne County

TARANTULA (Sonora)—Property recently purchased by ex-Governor Gage and associates, temporarily closed.

OMEGA (Sonora)—Water lowered to 300 level; drifts being retimbered. Shaft is 600 ft. deep; new drift will be run from that point.

BELL (Tuttletown)—Recently bonded to Boston men. Will be unwatered and development superintended by Paul S. Bernard. Wide low-grade vein. F. Sutton and Rowe brothers are owners.

COLORADO

Boulder County

ALLGROVE (Cardinal)—Flotation process installed in mill.

PRUSSIAN (Boulder)—Will be reopened in near future. Systematic development is planned.

McKENZIE (Nederland)—This mill east of town, formerly used for gold ores, is now running on tungsten ore.

NIL DESPERANDUM MINES CO. (Boulder)—New company recently incorporated by M. S. Brandt will reopen the mine. Active operations will be under way in about 40 days.

TUNGSTEN MOUNTAIN (Stevens Camp)—This 240-acre patented tract will be developed by J. G. Clark and associates. Sinking two shafts; lower tunnel, now 1,400 ft. long, will be advanced.

NELSON (Ward)—Being developed under management of Frank Eckel. Ore from development treated in mill equipped with plates, tables and slimers. Concentrate assays 1.76 oz. gold, 1.8 oz. silver and 20 to 65% tungstic acid.

BRACE (Boulder)—Being operated by Mitchell & Co., who recently opened 8-in. vein of 20 to 60% tungsten ore; concentrated at Degge-Clark mill. Recent shipment of 5,000 lb. ran 68%. Shaft will be sunk to 100 ft. and further equipment installed.

LIVINGSTON (Sugarloaf)—Winze on 400-ft. level continues in payable ore. Heavy flow in winze exceeds capacity of bailer and pump will be installed to handle 250 gal. per min. A motor-driven compressor will also be added. Oxidized ore near surface, considered not payable a few years ago, now treated at a profit.

Clear Creek County

QUEEN (Idaho Springs)—Tungsten ore being mined and treated in Mixell mill. Mine operated by lessees.

BIG FIVE (Idaho Springs)—Rohmer & Mudge lease on 100-ft. winze level of Lake property opened 20-in. shoot of shipping ore. First car shipped netted $25 per ton.

Gilpin County

SMUGGLER (Rollinsville)—Reported sold to Eastern men for more than $100,000.

BOODLE (Nevadaville)—Shipments of smelting and concentrating ore being made.

Lake County

IRON MASK (Leadville)—Opened large body of manganiferous ore.

LA PLATA (Leadville)—W. E. Bowden has installed electric pumping machinery for draining this California Gulch property.

Park County

WHEELER (Alma)—Operations resumed at this Mosquito Range property.

KANSAS (Alma)—Property on Loveland Mountain will resume in near future. Kansas Extension workings being cleaned out and repaired.

COMBINATION (Alma)—New tungsten discovery made on this claim. Hübnerite now found on both sides of Buckskin Gulch; chief discovery on north side of gulch in workings of old J. G. Blaine mine.

MAGNOLIA (Montgomery)—Old mill at Montgomery remodeled; process now consists of crushing, stamp milling in 10-stamp battery, amalgamation, and cyanidation of sands. Water power used in summer months and auxiliary steam plant in winter.

Saguache County

RALEIGH (Bonanza)—Stated operations will be resumed after 3 years shutdown. Long haulage and drainage tunnel driven, cutting workings at considerable depth. Complex sulphide ore.

San Juan County

LITTLE DORA (Silverton)—Mill repaired and test run on lead-copper ore made.

KLONDIKE (Eureka)—This group in Burns Gulch sold to Denver men. Zinc ore opened in tunnel.

IOWA-TIGER (Silverton)—Additional flotation unit being installed, increasing flotation capacity to 50 tons daily.

ADAMS (Gladstone)—First shipment of concentrates assayed 68% tungstic acid. Ore treated in North Star mill.

CHAMPION (Silverton)—Ore being treated at Silver Lake mill. Compressor and tramway repaired and work with good crew of men will be prosecuted.

MAYFLOWER (Silverton)—Work of building tramway from mine to Iowa mill progressing rapidly. Some ore to be treated in Iowa mill and some shipped direct to Durango smelting plant.

NORTH STAR (Silverton)—Milling plant being overhauled and flotation installed. Machines are of Bastion type, used in Gold King mill. Mine workings being repaired preparatory to steady operation.

San Miguel County

TOMBOY (Telluride)—In August, mill ran 30 days, crushing 13,000 tons; bullion yield, $46,800 concentrates $48,000; expenses, $66,800; operating profit $28,000.

Summit County

PUBLIC UTILITIES COMMISSION petitioned to restrain Denver & Rio Grande R.R. from removing third rail between Leadville and Salida. Removal would prevent use of narrow-gage cars over this portion of road and necessitate transfer of freight. This would particularly affect the mining towns of Breckenridge, Alma, Gunnison and, to some extent, Leadville.

CHIEF MOUNTAIN (Frisco)—Lead ore opened. Will ship soon.

ST. JOHN MINES (Montezuma)—Mill being remodeled and enlarged; flotation used; 25 men employed.

PIONEER CONSOLIDATED (Breckenridge)—This company, represented by Samuel Klous, of Boston, acquired 48 claims on Gibson Hill, including Dashwarren, Excelsior, Arab, Extension, Double Extension, Mascot, Jumbo and Jessie, also Extension 20-stamp mill, 160-acre placer tract, timber land, water rights, etc. Buliding road from Jessie mine to site of new mine buildings.

Teller County

STRONG (Victor)—Sinking continues in this Battle Mountain property.

MODOC MINING AND MILLING (Cripple Creek)—Producing 100 tons weekly.

STRATTON'S CRIPPLE CREEK MINING AND DEVELOPMENT (Cripple Creek)—Shipments being made by lessees from four properties on this estate.

IDAHO

Blaine County

NORTH STAR-TRIUMPH (Hailey)—Mine unwatered and mill of 300 tons capacity will be ready in about one month. A 6-mi. branch railway may be constructed jointly by the Oregon Short Line and Federal Mining and Smelting Co., which recently acquired control of this property.

Idaho County

GOLDEN SCEPTER (Elk City)—James McKinnon, owner of this placer, recently cleaned up about $1,000 in gold dust from a 30-day run.

HERCULES (Elk City)—Recently bonded to eastern Canada men and is being developed extensively. Vein exposed to 320-ft. depth by three tunnels; about 1,530 ft. of development. A 50-ton mill contemplated. John McDermid, superintendent.

Shoshone County

RAY-JEFFERSON (Wallace)—The 450-ft. raise connecting No. 1 and No. 2 levels cut 12 ft. of ore. New mill at junction of Beaver and Carbon Creek nearly completed.

HIGHLAND SURPRISE (Kellogg)—Sinking new shaft to open 4-ft. vein disclosed at depth of about 200 ft. by diamond drill. Shaft at 40 ft. encountered silver-lead-zinc vein, 30 in. wide. Mill operating one shift; increased recovery following installation of ball mill. W. W. Papesh, president.

CALEDONIA (Kellogg)—Net earnings for second quarter were $287,932 from 4,079 dry tons of concentrates and ore yielding $435,346 from following metals: Lead, 2,574,680 lb.; silver, 294,242 oz.; copper, 167,233 lb. Smelter deductions for freight and treatment $110,927; operating costs $36,486. Development on Keating Tunnel level did not disclose ore but is being continued. Company has about two years ore supply in sight.

RICHMOND (Saltese, Mont.)—Resumed shipping copper gold ore, the first-class ore going to Greenwood, B. C., and the second class (5 to 6% copper and $10 gold) to the Washoe works at Anaconda, Mont. Lower tunnel in 1,650 ft.; driving 280-ft. raise, in ore, to connect with old shaft. Property idle since 1910 when forest fires destroyed surface equipment and mine was flooded. Mine is near Adair but ships from Saltese, Mont., 4½ mi. Charles Heidenreich, manager.

MISSOURI-ARKANSAS

Joplin District

GARDNER (Aurora)—New mill on United Zinc Co. tract almost completed.

REBECCA (Joplin) — Taken over by Bayless & Hood, former owners. Mill started.

SYMMES (Joplin)—Closed down with bins full. May make improvements if market rises.

SANDRIGE (Aurora)—Draining ground near Scottish mine and will treat ore as well as tailing.

GREY EAGLE (Carthage)—Mill rebuilt and operating once more, at present only on tailings, but ground is being drained.

WALKER (Cardin, Okla.)—Unable to start new mill, account scarcity of water. Sinking mill shaft to lower level, 210 ft. Good ore at 120 ft.

D. C. & E. (Webb City)—Installing 12-in. Layne & Bowler oil-balanced pump, capacity 1,700 gal. per min., at No. 2 mine. First of these pumps to be tried in this district.

ONAMENA (Duenweg)—At No. 2, formerly Wilson mine, good ore cut in new shaft southeast of mill. Planning aërial tramway for transporting ore. Shaft was put down on one of richest holes ever brought in in Duenweg camp.

Northern Arkansas

PHILLIPS (Yellville)—New mill completed but lack of water will prevent full operations for present.

MORNING STAR (Rush)—Installed 2,000-ft. trackage to bring ore from Capps property. Mules hauling three to five tons per trip.

SURE POP (Buffalo Creek)—After two years' steady operation, this mine averaging 14 tons concentrates and shipping ore, daily, from mill of less than 100 tons capacity.

MONTANA

Jefferson County

BOSTON & CORBIN (Corbin)—New 100-ton flotation plant placed in operation Aug. 16.

Granite County

NORTHWESTERN MINES CONSOLIDATED CO. (Maxwell)—Shaft, sunk 700 ft. from portal in main tunnel, passed through an 8-ft. vein, carrying from 6 to 10% copper, 4 oz. silver and traces of gold. Six cars of concentrates, shipped to Anaconda smeltery during July, netted $3,000. Damage to power plant by recent cloudburst, necessitated temporary shutdown of mill.

Lincoln County

ROSE CONSOLIDATED (Libby)—Recently made shipment of 2,561 lb. of tungsten concentrates. Ore also contains gold and 10-stamp mill is practically completed. Crosscut tunnels have opened 5-ft. vein at 180-ft. depth about 800 ft. apart. P. S. Rose, superintendent. Oscar Nordquist, of Wallace, Idaho, manager.

SNOWSTORM MINES CONSOLIDATED (Troy)—Standard-gage railway from Troy to millsite of company's Banner and Bangle group of mines completed. Hydro-electric plant well under way and transmission line being built. About $500,000 is being expended in mill, compressor, power plant and railway for exploitation of the silver-lead-zinc ores.

Powell County

MONTANA-CLINTON (Elliston)—May construct hydro-electric plant on Telegraph Creek to operate its Julia and Monarch mines in Elliston district. Propose to further develop the Julia by 2,000-ft. tunnel to tap orebodies and to drain property.

Silver Bow County

BUTTE-DETROIT (Butte)—Equipment for the Ophir mill now arriving and being installed.

BUTTE-DULUTH (Butte)—Leaching operations expected to begin about Nov. 1. Al Frank and associates, lessees.

EAST BUTTE (Butte)—August output was 1,849,120 lb. copper and 49,449 oz. silver, as compared with 1,893,120 lb. copper and 48,892 oz. silver in July.

BUTTE & SUPERIOR (Butte)—August output at company's Black Rock mine was reduced almost a third from normal on account of accident to shaft causing closing of mine and mill for 10 days. Ore production was about 34,000 tons, against the usual 50,000. Production of zinc concentrates was 9,600 tons, containing 10,475,000 lb. of zinc. Recoveries in August, 94.5%. Produced 300 tons of lead concentrates and 192,000 oz. of silver. Company will raise regular dividend from $3 a year to $5. Extra quarterly dividend cut from $10 in preceding quarter to $5.

NEVADA

Humboldt County

GOLDBANKS QUICKSILVER CO. (Winnemucca)—Has its reduction plant in operation and is shipping quicksilver regularly.

WINNEMUCCA MOUNTAIN MINING CO. (Winnemucca)—New gold mill has been started and is gradually being tuned up to capacity.

Nye County

TONOPAH ORE PRODUCTION for week ended Sept. 2 was 9,872 tons, valued at $203,576, as compared with 8,916 tons for week previous. Producers were: Tonopah Belmont, 2,884 tons; Tonopah Mining, 2,300; Tonopah Extension, 2,200; Jim Butler, 1,100; Montana, 230; North Star, 53; miscellaneous, 30 tons.

Storey County

ANDES (Virginia)—Saved 30 tons from development on 350 level; shipped 42 sacks concentrate.

COMSTOCK PUMPING ASSOCIATION (Virginia)—Retimbering 2,700 station of Mexican-Ophir winze about completed.

OPHIR (Virginia)—South stope above 2,700 level shipped 20 tons, averaging $24.65. North drift in dacite and quartz at 315-ft. point.

UNION CON. (Virginia)—Extracted 415 tons, gross value $7,000. From 2,400 level, 212 tons averaging $17.12; 115 tons $17.10; 46 tons $12.52; 22 tons $14.21; 2,500 level, 20 tons $16.49.

MEXICAN (Virginia)—West crosscut 2,500 level advanced to 416-ft. point, face in diorite. Mexican mill received 435 tons ore averaging $17.64 and 30 tons from Mexican storage averaging $10.39.

UTAH

Beaver County

MAJESTIC (Milford)—Has started sinking Hoosier Boy shaft to greater depth. Now 600 ft. deep. Stoping tonnage will be maintained. Old Hickory property shipping about 10 cars of copper-iron ore monthly.

Juab County

GEMINI (Eureka)—Ore running high in silver and lead mined from Carlson-Backman lease on 1,400 level.

SIOUX CONSOLIDATED (Eureka)—Night shift to be put on in sinking winze from 600 for continuation of Iron Blossom copper deposit. Main shaft may also be deepened.

CHIEF CONSOLIDATED (Eureka)—Larger compressor to be installed at Homansville shaft; now down 475 ft. Some manganese ore, carrying 40% Mn, being shipped from Homansville property.

TINTIC STANDARD (Eureka)—Lead ore opened on 1,600-ft. level, and drifted on for 50 ft. New compressor recently installed, and shaft being sunk. Ventilation on lower levels improved by larger fan.

Piute County

DEER TRAIL (Marysvale)—A 2-mi. pipe line will be laid from Threemile Cañon.

WHITE HORSE POTASH (Marysville)—Three claims, 2½ mi. northeast of Marysvale, under option to B. H. Payne.

Salt Lake County

HOWELL (Salt Lake)—Recently shipped car of ore from this mine in Big Cottonwood Cañon.

CARDIFF (Salt Lake)—Promising find of lead-silver ore in west drift, which is being driven 2,600 ft. from mouth of tunnel.

UTAH COPPER (Bingham)—Maintained an average daily output of 36,000 tons during August, as compared with 34,000 tons a day in July.

COLUMBUS-REXALL (Alta)—Columbus Extension and Rexall consolidated under above name. Stocks withdrawn from Salt Lake exchange, and new stock will be listed. Air connections made through Frederick tunnel. Main tunnel on Little Cottonwood side to be continued along Cardiff contact to boundary of properties.

Summit County

PARK CITY SHIPMENTS for August were 9,602 tons, an increase of 224 tons over July. Silver King Coalition shipped 2,833 tons; Judge Mining & Smelting, 1,508; Silver King Consolidated, 2,215; Daly West, 1,137; Big Four, 1,022; Ontario, 352; Park City Mines, 60; W. E. Jones, 80; Utah Ore Sampling, 32 tons.

ONTARIO (Park City)—Lessees working about 70 men.

DALY-JUDGE EXTENSION (Park City)—Shaft is being sunk.

SILVER KING CONSOLIDATED (Park City)—New development and drain tunnel in 250 ft. Good progress being made.

DALY WEST (Park City)—Development being done on the 1,400, 1,700 and 2,000 levels. Increased shipments of crude ore made. Mill handling about 100 tons a day. Working 100 men at mine and mill.

Tooele County

LION HILL (Ophir)—Car shipped from St. Clair lease brought good returns principally in silver.

KEYSTONE DEVELOPMENT (Stockton)—Incorporated Sept. 6 to acquire producing properties in Stockton. Include Galena King, South Port Mining, and Merwin, held by Eastern estates and for some time idle except for work by lessees. Claims extend for 8,000 ft. along strike of lode. Capitalization is 1,000,000 shares, par value 10c., with 500,000 shares in treasury. J. B. Overton, Duncan Mac Vichie, W. C. Alexander, David Keith, L. H. Farnsworth of Salt Lake City are interested.

Utah County

SOUTH PARK (American Fork)—Silver ore opened at surface between Smuggler and Osborne claims.

BELEROPHON (American Fork)—Raising from tunnel level has cut bedded ore showing galena. Drifting started.

UTAH CENTENNIAL (American Fork)—Rock mineralized with lead and silver cut by tunnel. J. W. Thorne manager.

WYOMING

PENN-WYOMING COPPER CO. assets and those of its successor, the United Smelters, Railway and Copper Co. will be sold at Cheyenne, Sept. 21. Claims total $2,376,750. Bonds of subsidiaries will be sold in following order: $518,500 Saratoga and Encampment Ry.; $500,000 Encampment Smelting Co.; $100,000 Encampment Pipe Line Ditch Co.; $50,000 Emerson Electric Light Co.; $350,000 Encampment Tramway Co.; $50,000 Encampment Waterworks Co.; $8,000 Encampment Land and Town Lot Co.; $750,000 Battle Lake Tunnel Site Mining Co.; $1,000,000 Haggarty Copper Mining Co.; $20,000 Carbondale Coal Co.; and $22,000 North American Mercantile Co.

WASHINGTON

Ferry County

SHIPPING MINES in Ferry County during first eight months and their tonnages were: Ben Hur, 2,099 tons; Knob Hill, 1,729; San Poil, 7,728; Tom Thumb, 267; Delphia at Danville, 29 tons; Iron Creek at Keller, 21. First four mines are at Republic.

Stevens County

SHIPPING MINES in Stevens County during first eight months, with shipping point and tonnages were: Bonanza at Bossburg, 345 tons; Edwards, Valley, 13; Electric Point, Boundary, 1,047; Kokoma, Boundary, 5; Lead Trust, Boundary, 9; Loon Lake Copper, Loon Lake, 30; Monarch, Chewelah, 18; United Copper, Chewelah, 6,600; Norman, Northport, 28; Columbia Copper (Turk), Deer Trail, 48; Deer Trail, Deer Trail, 4.

ADMIRAL (Valley)—Recently made preliminary shipment. Force to be doubled next month.

HECLA (Chewelah)—This Cœur d'Alene company will begin shipments from its copper-silver group on completion of a 1½-mi. wagon road.

SPOKANE BELLE (Valley)—Tungsten ore recently opened at this old silver mine. E. H. Belden, of Spokane is developing and may sink shaft to 350-ft. level.

CANADA

British Columbia

GRANBY (Grant Forks)—Seventh furnace blown in Sept. 7; eighth furnace may soon be started as steady coke deliveries by Crows Nest Pass Coal Co. now seem assured.

GRANBY (Anyox)—Receiving from company's Midas mine, Valdez, Alaska, about 3,000 tons monthly and from the Mamie on Prince of Wales Island, Alaska, from 4,000 to 5,000 tons monthly. Ores brought by company's own steamers.

Ontario

DAVIDSON (Porcupine)—Fire on Sept. 4 destroyed office building; fully insured.

JUPITER (Porcupine)—Rich extension of orebody on 400 ft. level, where vein is 2 ft. wide.

VIPOND (Porcupine)—Production in August from about 4,000 tons of ore was approximately $20,000 and operating expenses $11,500.

WEST DOME CONSOLIDATED (Porcupine)—Plans for mill completed and it is proposed to lay foundations this fall and carry on construction through the winter.

DOME MINES (South Porcupine)—In August, milled 40,010 tons—record tonnage. Yield was approximately $180,000 or $4.49 per ton; operating costs were $2,56, which is 6c. lower than in June and 5c. below the July costs.

AUGARITA (Porcupine)—Three diamond-drill holes down about 450 ft. each; 3 veins have been cut, one showing free gold. Main vein, stripped for about 1,700 ft. on the surface, is from 30 to 80 ft. wide.

PORCUPINE CROWN (Timmins)—Vein recently encountered in running a winze from 700- to 800-ft. level is not a new one, but is regarded as important owing to high grade of ore. Winze being continued to 900-ft. level, the vein, 4 to 6 ft. wide.

HOLLINGER CONSOLIDATED (Timmins)—In four weeks ended Aug. 11, gross profits were $220,357, from 43,387 tons of ore; average value $9.61 per ton; working cost $3.78 per ton milled. Expenditures on plant account during period were $44,689. Long crosscuts being made to connect workings in the outlying section of the property with the main shaft. Electric-tramming system will be extended to these, so that when new mill addition is started, next summer, ore will be hauled from points a mile distant.

MEXICO

CANANEA CONSOLIDATED (Cananea, Son.)—August copper production was approximately 5,000,000 lb., as compared with 4,600,000 lb. in July.

ESPERANZA (El Oro, Mex.)—Loss on June operations £572. Production low due to temporary strike and to withdrawal of operating staff from property.

SANTA GERTRUDIS (Pachuca, Hidalgo)—Crushed in July 20,292 tons; estimated profit £1,449; June profit £3,434. Pump station established on 22nd level. Report for quarter ended June 30 gives following review of operating conditions in Pachuca district: "International complications between the Mexican and U. S. Governments, while temporarily arranged, may come up again any time. We have for this reason released all American employees for an indefinite period. The timber situation continues serious; after making four trips our El Oro special train service was cut off by reactionary elements in control of the railroad over which we had to operate. Since then our train contract has expired, with no present chance of renewal. We are making every effort possible to increase deliveries from local sources, but these are limited by the railroad service, which at best is bad, and at frequent intervals entirely absent. The question of labor is not one so much of supply as of attitude. The men are now overpaid and exceedingly independent. They work less hours per day, less days per week, and are more inefficient while at work. All experimental work in hand and still uncompleted was dropped at the time of the recent exodus of Americans. There are no men available at the present time capable of carrying on this work. The profit for the quarter was considerably reduced, due principally to lower grade of ore, lower price of silver and increased labor cost. This condition is likely to be accentuated during the present quarter, and it may be possible that the company may even make some actual loss in the immediate future."

AFRICA

RHODESIAN GOLD PRODUCTION in July is reported at 77,000 oz., being 2,518 oz. less than in June. This makes for the seven months ended July 31 a total of 539,055 oz. Other production for July was 18,446 oz. silver, 347 tons copper, 452 tons asbestos, 8,758 tons chrome ore and 43,403 tons coal. The shipments of diamonds were 94 carats.

The Market Report

Metal Markets

NEW YORK—Sept. 13, 1916

All of the markets were very strong and active during the last week. In both lead and spelter there were advances. In copper the range in price became large, according to delivery, there being important transactions for the first quarter of 1917.

Copper, Tin, Lead and Zinc

Copper—A very large business was done, both for domestic and foreign account. There was large buying by American brass manufacturers, which was understood to be for the purpose of covering a large contract for rods previously taken. Some more business of this nature is pending. The sales of the week were for the fourth quarter of 1916 and the first quarter of 1917, the major market now including both of those periods. All of the large producers participated in this business. Widely different prices were accepted according to delivery, wherefore the range in quotations of the market is unusually large.

The transactions of which we had reports amounted to about 30 million pounds. The total sales for the week were undoubtedly upward of 50 million pounds.

Reports are confused with respect to the Russian order that was placed during the week. It seems that more copper was bought for this account than had previously been talked about, the buyer evidently having asked several concerns to make tenders on a certain quantity and then taking it, or a large part of it, from each of them.

Negotiations for a large quantity of copper for the Allied Governments, which were interrupted recently, have been resumed.

The first electrolytic copper refined in Canada was turned out Aug. 20 at the new refinery at Trail, B. C., built by the Consolidated Mining and Smelting Co., of Canada. The plant has a capacity of 10 tons daily.

The Department of State is in receipt of information to the effect that an agreement has been entered into between the Governments of Great Britain and Norway, whereby the Government of Norway places an embargo on the exportation of raw copper and receives without interruption importations of copper from the United States, but releases an amount equivalent to such importations for shipment to England. It is understood that about 3,000 tons will be at once available.

Copper Exports from Baltimore for the week included 1,029,114 lb. copper and 916,364 lb. brass disks to Havre, France; 3,360,371 lb. copper to Liverpool, England; 3,023,978 lb. copper to Archangel, Russia.

Copper Sheets are nominal at 37.5c. per lb. for hot rolled and 38.5c. for cold rolled. Copper wire is 31.5@32c. per lb. for large lots at mill.

Tin—This market was almost idle. The changes in price were insignificant.

Lead—A large business was done, chiefly for domestic account, but there were some important foreign orders. Lead for September shipment has become very scarce indeed and the market in this metal is now chiefly for shipment in October and later. The situation is such that the market has passed quite out of the hands of the principal producer and the pace is being made by the outsiders.

Spelter—A very large business was done, especially with brass makers who purchased to cover a large contract for rods that they had taken. The largest purchases were for delivery from December to February, but there was also important business for prompt and near-by shipments. The buying began in the early part of the week at about 8¼c and the market was rapidly brought upward. At 9c., selers who had previously been standing aloof entered the market. The largest part of the business in spelter was associated with some of the large buying of copper.

Exports from Baltimore for the week included 224,041 lb spelter to London.

Zinc Sheets are in steady demand and business is fair. Quotations are unchanged at $15 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—Sept. 13

Aluminum—Spot material is still scarce and deliveries are mainly on contract. Demand is good and seems to exceed supplies. Prices are firmer but rather nominal at 61@63c. per lb. for No. 1 ingots, New York.

Antimony—This market continued dull at unchanged prices. We quote 12@12½c. However, there seems to be a slightly better tone, due largely to the refusal of some of the largest producers to take business at present prices.

Quicksilver—This market became very dull. Producers reduced their price to $75. San Francisco reports by telegraph $75, market fair.

Nickel—Demand is good both from domestic and export business. Prices are firm and unchanged at 45@50c. per lb. for ordinary forms, according to size of order. A premium of 5c. per lb. is charged for electrolytic nickel.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.30 per lb., New York—**Cadmium** is quoted at $1.30@1.50 per lb.—**Cerium**, electrolytic, is sold at $8@9 per lb.—**Cobalt Metal** is quoted at $1.25 per lb.—**Magnesium** is steady, with sales at $3.50@3.75 per lb. for 99% pure—**Selenium** is from $3 up to $5 per lb., according to size of order.

Gold, Silver and Platinum

NEW YORK—Sept. 13

Gold Imports in the United States in July are reported by the Department of Commerce at $62,107,665; exports, $9,395,035; excess of imports, $52,712,630, which compares with an excess of imports of $15,071,203 in 1915, and an excess of exports of $30,277,709 in 1914.

Gold Production in the Transvaal in August is reported at 781,150 oz., being 20,063 oz. more than in July, and 2,387 oz. more than in August, 1915. For the eight months ended Aug. 31 the total was 6,174,104 oz., or $127,618,730; being 216,938 oz. more than last year.

Gold in the United States on Sept. 1 is estimated by the Treasury Department as follows: Held in Treasury against outstanding gold certificates, $1,619,201,489; in Treasury current balance, $288,506,199; in banks and circulation, $640,533,785; total, $2,548,241,473. This is an increase of $491,509,335 over Sept. 1 of last year.

Platinum—There was a further advance in this market. Principal producers report sales at $85 for refined platinum.

Silver—The market has ruled fairly steady the past week between 32 5/16 and 32 9/16d. in London, and closes firm at 32⅜d. bid. Shipments from New York to London continue moderate and with continuance of buying for English Mint and Continental coinage the undertone is healthy. There have been large shipments of late from San Francisco to China which is interesting in view of the situation of Chinese exchanges.

Mexican dollars were quoted in New York Sept. 7 at 52⅜@55⅜c.; Sept. 8 at 52⅜@55⅝c.; Sept. 9 at 52⅜@55⅜c.; Sept. 11 at 52⅜@55⅜c.; Sept. 12 at 52⅛@55⅛c.; Sept. 13 at 52@55 cents.

Silver Exports from the United States in July were valued by the Department of Commerce at $4,336,598; imports, $2,425,782; excess of exports, $1,910,816, which compares with $962,578 in 1915, and $2,712,852 in 1914.

Coined Silver in the United States on Sept. 1 is estimated by the Treasury Department as follows: Standard dollars, $568,270,900; subsidiary coins, face value, $188,015,961; total, $756,286,861. Of the dollars, $482,006,557 are held in the Treasury against outstanding silver certificates.

Corrected and final statements from the Department of Mines put the silver production of Canada at 28,449,821 oz. in 1914, and 28,401,735 oz in 1915; a decrease of only 48,086 oz., or 0.17% last year.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 9—Price quotations per 2,000 lb.: Blende, high, $64.90; per ton 60% zinc, premium ore, no sales, medium grades $60@55, low $50; calamine, per ton 40% zinc, $35@30; average selling price, all grades of zinc, $58.09 per ton. Lead, base price, $70@65, per ton 80% metal content. High price, $70 20. Average selling price, all grades of lead, $67.65 per ton

Shipments of the week: Blende, 3,361 tons; calamine, 496 tons; lead, 1,297 tons. Value, the week, $312,060; the year to date, $26,531,630

The investigation by the Producers' Association into the aggregate tonnage of reserve stock of zinc ore distributed over the district was most timely and aroused mine owners to the necessity of further limiting production. As a result, and to forestall possible labor trouble by the scheduled wage reduction for September, several mines closed on Sept. 1.

The report of holders of ore, estimating a stock of 23,000 tons the week ending Aug. 26, was a near coincidence with the reports for smelters, showing for the same week 23,360 tons. So close are the two estimates as to practically confirm both. The next occurrence to upset ore production is the strike of coal miners in

SILVER AND STERLING EXCHANGE

Sept.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Sept.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
7	4.7575	67⅞	32 5/16	11	4.7575	68	32⅜
8	4.7575	68⅛	32½	12	4.7575	67⅞	32 5/16
9	4.7575	68⅛	32 5/16	13	4.7575	68	32⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Sept.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
7	26½ @27½	39	6.55 @6.70	6.40 @6.60	8.25 @8.50
8	26½ @27½	38¾	6.60 @6.70	6.45 @6.60	8.37½ @8.62½
9	26½ @27½	38¾	6.60 @6.70	6.50 @6.60	8.37½ @8.62½
11	26½ @27½	38½	6.65 @6.70	6.50 @6.60	8.50 @9.00
12	26½ @27½	38½	6.65 @6.75	6.55 @6.60	8.75 @9.25
13	26½ @27½	38½	6.65 @6.75	6.55 @6.60	8.87½ @9.37½

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only St. Louis price is given, St. Louis being basing market. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Sept.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
7	109½	106½	131	170¾	171¾	30½	48½
8	110	107½	131	170	170¾	30¼	50
9	....	....	....	....	....	....	....
11	111	108	131	169½	170½	30	50
12	111	108	132	169½	170¼	30	52
13	114½	110½	132	169¾	170¾	30	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. Copper quotations for electrolytic are subject to 3% discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜ cents.

the Kansas coal fields. The strike should have no very serious effect on this district, as the dependence upon coal-fuel power is limited. Natural gas and electricity furnish the larger proportion of power.

Platteville, Wis., Sept. 9—Quotations for the week are according to the following figures: Base price per 2,000 lb. ton for material assaying 60% zinc is $56 for premium ore down to $50 for medium grade. For material assaying 80% lead the base price per 2,000 lb. ton is $71. Shipments for the week were 3,094 tons of zinc ore, 147 tons of lead ore and 907 tons of sulphur ore. For the year to date, the figures are 84,669 tons of zinc ore, 3,031 tons of lead ore, and 20,220 tons of sulphur ore. Shipped during the week to separating plants, 3,780 tons of zinc ore.

OTHER ORES

Manganese Ore—Brazilian ore continues to be quoted at about 60c. per unit at seaboard; Indian ore at 50@55c. per unit.

Arrivals at Baltimore for the week included 12,655 tons manganese ore from Brazil.

Tungsten Ore—Exports of tungsten ore from Japan in 1915 were 85 tons to the United States, 214 tons to France, and 110 tons to the United Kingdom; 409 tons in all. Estimated shipments to July, 1916, are placed at 480 tons, most of it going to the United States. The tungsten output of Japan is reported as 25 to 40 tons of ore per month from the Kiwada mine, 10 to 11 tons per month from the Takitori mine, and 75 tons per month from several small mines. Those in Chosen produce between 50 and 60 tons per month.

Tungsten Ore—Following the large business consummated in recent weeks this market became very dull. Small quantities are still offered around $17 per unit, which we quote as the market. However, most of the interests in New York that have this ore for sale are holding for $20. It is reported that the Atolia Mining Co. has closed its mill for repairs, and it is thought that the withdrawal of this production may have a stiffening effect on the market.

Antimony Ore—This market is a little firmer. A small business was done at $1@1.10 per unit for immediate delivery.

EXPORTS AND IMPORTS

Spanish Ore and Mineral Exports, six months ended June 30, as reported by "Revista Minera," in metric tons:

	1915	1916	Changes
Iron ore	2,161,930	2,366,439	I. 204,509
Copper ore	26,053	26,871	I. 818
Zinc ore	13,227	57,170	I. 43,943
Lead ore	385	1,196	I. 811
Manganese ore	4,534	2,310	D. 2,224
Pyrites	828,492	1,543,340	I. 714,848
Salt	248,760	232,438	D. 16,322

Imports of coal for the half-year were 857,017 tons, an increase of 100,621 tons; of coke 86,652 tons, a decrease of 7,560 tons.

Iron Trade Review

NEW YORK—Sept. 13

The position of the iron and steel markets continues extremely strong. While at present the new demand for steel is only moderate, the mills are so fully sold up that there is a strong market, and premiums for early delivery are paid on as many classes of finished steel as formerly, even lap-weld pipe being held at premiums by many mills. In the past three months, despite the apparently quiet market, the mills have booked substantially as much business as they have filled and they regard it as settled that there will be heavy pressure for deliveries for 10 or 12 months to come.

While there is a feeling of relief in the iron and steel industry that the threatened railway strike did not occur, there are apprehensions over the unrest in iron and steel labor caused by the manner of settlement. Some observers who appear to be in close touch with the situation predict that before the end of the year there will be strikes for an eight-hour day, to replace the 10 and 12 hours worked by many of the men. Such a demand could not be granted, irrespective of the cost of production, as there would not be enough men to maintain the output. There is no surplus now, rather some scarcity of labor.

The strongest home demand at present is for plates and shapes for shipbuilding. The ship yards are all full of work and are in need of material. Structural work is about the same as last reported, with many small contracts to be placed, but only a few large ones under consideration. Railroad business is larger. Some large foreign orders have been placed, and the rail mills are sure of abundant work next year.

The pig-iron market has been a little quieter, though there is still a heavy demand for basic iron, and foundry pig is selling quite freely, especially in seaboard territory.

Exports from Baltimore for the week included 4,197,051 steel billets, bars and forgings, 909,617 lb. pipes and tubes, 226,082 lb. wire, 717,704 lb. nails and 408,730 lb. tinplates to Great Britain; 14,750,425 lb. steel billets and blooms, 3,981,363 lb. steel rails and fastenings and 1,306,830 lb. pig iron to France; 4,640 tons old rails and scrap to Italy.

United States Steel Corporation common stock on Sept. 8 sold over par on the New York Stock Exchange. Later it went even higher, selling Sept. 9 up to 103⅛, Sept. 12 it sold at 105½ and promises to go higher.

The United States Steel Corporation reports unfilled orders on its books Aug. 31 at 9,660,357 tons of material. This is 66,765 tons more than on July 31, but is 277,441 tons less than the maximum reached on May 31. It is 4,751,902 tons more than on Aug. 31 of last year.

Pig-Iron Production in August showed a slight decrease from July. The reports of the furnaces, as collected and published by the "Iron Age," show that on Sept. 1 there were 320 coke and anthracite stacks in blast, having a total daily output of 104,500 tons, being 1,100 tons more than on Aug. 1. Bad weather and scarcity of labor kept down production during the month. Making allowance for the charcoal furnaces the total make in August was 3,240,700 tons; for the eight months ended Aug. 31 it was 26,121,700 tons. Of the total production 18,440,860 tons, or 70.6%, were made by the furnaces owned or operated by the steel companies.

PITTSBURGH—Sept. 12

The Steel Corporation's gain during August of 66,735 tons in unfilled obligations was less than had been expected in the trade but the showing is distinctly favorable in that it follows two months of decreases. The tonnage reported on books would carry the corporation into next April, on an average, but bars, plates, shapes and rails are sold much farther ahead than this, while wire products, sheets, tinplates and pipe mill products are sold a much smaller distance ahead, the divergence being due chiefly to differences in trade habits.

The steel mills regard it as assured that they will have full operation until the middle of next year, at the least, and on the surface the steel market promises a fulfillment of the expectation, but there are many doubters among the ranks of buyers. There are many who believe consumption in important lines will be reduced when it is necessary to pay the present prices on actual shipments, for at present there is still considerable cheap steel being shipped. The jobbers are particularly doubtful.

Steel production is increasing as the hottest weather has been passed but doubts are expressed whether October will show its usual large tonnage, as labor is scarce. The restricted production of the past two months has certainly helped to support the situation.

The general tone of the steel market is aided by the unwillingness of the great majority of mills to sell unfinished steel, except the fancy priced war steel, for delivery in the first half of the new year, as well as the tendency pig iron is showing to grow scarce and advance in price. Higher prices are claimed to be bid for scrap, particularly heavy melting steel.

Pig Iron—The buying movement has broadened further. The Brier Hill Steel Co., formerly a regular seller, has bought 20,000 tons of basic pig iron, but whether because its enlarged steel plant is outrunning its pig-iron production or because the company prefers to sell bessemer and buy basic is not disclosed. The United Steel Co. at Canton has also bought 20,000 tons of basic, and there are rumors of other purchases. The Standard Sanitary Manufacturing Co. today closed on purchases of 25,000 tons of foundry, about two-thirds southern, paying $14 and $14.50, Birmingham, for the southern and $18.50 at furnace for the northern. It is using half southern iron in its Pittsburgh district plants now, on account of the more favorable delivered price. Reports are that the merchant furnaces are almost fully sold for the remainder of this year and there are more predictions of an impending scarcity and a sharp advance. We quote: Bessemer, $21@21.50; basic, $18@18.25; malleable and foundry, $18.50@18.75; forge, $18@18.25, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—Reports are confirmed that there have lately been heavy sales to foreign consumers of shell steel billet discards, practically cleaning up the accumulations and making the unfinished steel situation still stronger. There are only occasional odd lots of soft steel offered for this year's delivery, and for next year the mills generally refuse to quote. The market is regarded as $45@50 for soft steel, bessemer or openhearth, but practically nominal at this range or any other.

FERROALLOYS

The production of ferromanganese and spiegeleisen in the United States, eight months ended Aug. 31, is reported at 133,934 gross tons in 1915, and 253,837 tons in 1916; an increase of 119,903 tons this year.

Ferrosilicon is nominally unchanged. High-grade, 50%, is quoted at $86@89 per ton at furnace, according to size of order. Bessemer ferrosilicon ranges from $30 for 9% up to $41 for 16%, at furnace.

Spiegeleisen, 20%, brings $40@45 per ton at furnace, with high grade, 25 to 30%, quoted at $55@65 per ton.

Ferromanganese—The market shows a somewhat easier tone, prompt being usually available at $170 or a shade less, while there is some domestic offered on contract at this figure, imported on contract remaining at $175. Fears of a shortage appear to be entirely allayed.

Arrivals at Baltimore for the week included 2,075 tons of ferromanganese from Liverpool.

FOREIGN IRON

German Pig-Iron Production in July is reported by the German Iron and Steel Union at 1,134,306 metric tons, being 52,799 tons more than in June. For the seven months ended July 31 the production was 6,581,840 tons in 1915, and 7,631,338 tons 1916; an increase of 1,049,498 tons. The make for the seven months in 1914, before the war, was 10,852,192 tons; so that this year's make was a little over 70% of that of a normal year.

IRON ORE

Shipments of iron ore from the Lake Superior region by ports are reported by the "Iron Trade Review" as follows, in gross tons, for the season to Sept. 1:

Port	1915	1916	Changes
Escanaba	2,995,862	4,708,477	I. 1,712,615
Marquette	1,773,653	2,469,705	I. 696,052
Ashland	2,801,219	4,796,384	I. 1,995,165
Superior	4,439,088	7,815,795	I. 3,376,707
Duluth	9,378,530	12,718,548	I. 3,340,018
Two Harbors	5,418,068	6,706,955	I. 1,288,887
Total	26,806,420	39,215,864	I12,409,444

The shipments for the season at this rate will easily reach 60,000,000 tons and perhaps exceed that figure, even if there should be an early close of navigation. The August shipments were 9,850,140 tons, the largest on record.

COKE

The Alabama coke market is strong and supplies are hardly up to the demand. Coke production in the Birmingham district is being rushed.

Connellsville—Bids of $2.85 were made this morning for a few carloads of furnace coke for shipment today. The market is quiet with very light offerings and small inquiry. There is ample oven capacity but labor is scarce. Car supply has become practically normal again. We quote: Spot furnace, $2.80@2.85; contract, nominal, $2.50@2.75; prompt and contract foundry, $3.25@3.50, per net ton at ovens.

Anthracite Shipments in August are reported at 5,531,797 gross tons, which is 98,919 tons more than in July and 69,670 tons more than in August, 1915. For the eight months ended Aug. 31 the total shipments were 42,894,783 gross tons in 1915, and 44,386,340 tons in 1916; an increase of 1,491,557 tons this year.

Chemicals

NEW YORK—Sept. 13

The general market is improving, showing a stronger tone and increased business. The heavy chemicals generally report sustained prices and more interest in futures.

Arsenic—Supplies are equal to the demand, which continues moderate. Quotations are unchanged at $6@6.25 per 100 lb., for both spot and futures.

Copper Sulphate—Demand seems to be improving and there are more inquiries for export material. Prices have again hardened a little and sellers are quoting $9@11 per 100 lb., according to size and terms of order.

Nitrate of Soda—Demand is reported as improving, the statistical position is not strong, owing to large production and prospective imports, in addition to good stocks on hand. Nevertheless prices are firm, and sellers continue to quote $3 per 100 lb. for both spot and futures.

Sulphur—A fair business is forward and prices are firm. Spot material is scarce and commands a premium, sellers holding for $35 per gross ton. Futures can be had at about $30 per ton for November and later.

Sulphuric Acid—Business is fair and there is some inquiry for futures, including some large contracts. Prices are steady at $1 per 100 lb. for 60-deg. and $1.50 per 100 lb. for 66-deg. acid.

Magnesite shipments from Greece in 1915 are given by U. S. Consul General A. W. Waddell, of Athens, as follows, in metric tons:

To	Raw	Calcined	Total
United States	33,641	6,318	39,959
England	43,545	7,627	51,172
Other Europe	15,475	4,781	20,256
Total	92,661	18,726	111,387

All Grecian magnesite mines are located in the Athens district, most of them being on the Island of Euboea. In 1914 the mines produced 117,430 metric tons of raw magnesite. The total 1915 output is placed at 133,858 tons. The United States bought more heavily in 1915 than formerly.

Assessments

Company	Delinq.	Sale	Amt.
Alta Silver, Nev.	Sept. 1	Sept. 25	$0.03
Beaver Gold, Utah	Aug. 19	Sept. 16	0.01
Beaver Mines, Utah	Sept. 30	Oct. 21	0.0025
Blue Star, Ida.	Sept. 25	Oct. 21	0.02
Bull Valley, Utah	Oct. 10	Oct. 31	0.004
Cash Boy, Nev.	Sept. 1	Oct. 15	0.01
Challenge, Nev.	Aug. 23	Sept. 13	0.05
Coal Creek, Ida.	Aug. 25	Sept. 26	0.005
Con. Virginia, Nev.	Sept. 29	Oct. 20	0.05
Crown Point, Utah	Sept. 16	Oct. 10	0.005
Eagle Mountain, Ida.	Oct. 2	Nov. 4	0.001
Exchequer, Nev.	Sept. 5	Sept. 26	0.03
Emerald, Utah	Aug. 15	Sept. 9	0.00½
Fortuna, Utah	Aug. 25	Sept. 14	0.005
Friend, Ida.	Aug. 26	Sept. 16	0.002
Great Bend, Nev.	Aug. 15	Sept. 20	0.01
Great Western, Nev.	Sept. 26	Oct. 18	0.01
Hector, Ida.	Aug. 7	Sept. 15	0.005
Idaho-Nevada, Ida.	Sept. 14	Oct. 14	0.002
Jacket-C.Point-Belcher, Nev.	Aug. 14	Sept. 7	0.05
Leonora, Utah	Sept. 27	Oct. 16	0.005
Nevada-Stewart, Ida.	Aug. 3	Sept. 2	0.003
Nevada Zinc, Nev.	Aug. 14	Sept. 2	0.01
Old Veteran, Ida.	Sept. 9	Oct. 7	0.002
Paloma, Utah	Aug. 21	Sept. 9	0.01
Phedora, Ida.	Aug. 29	Sept. 29	0.001
Rio Grande Grubstake, Nev.	Sept. 22	Oct. 31	0.002
Sandstorm Kendall, Nev.	Aug. 22	Sept. 26	0.01
Santaquin Chief, Utah	Sept. 11	Sept. 21	0.0025
Santaquin King, Utah	Sept. 11	Sept. 21	0.0025
Sells, Utah	Sept. 21	Oct. 7	0.06
Silver Pick, Nev.	Sept. 25	Oct. 30	0.01
Smuggler, Utah	Sept. 20	Oct. 18	0.005
Springfield Tunnel, Calif.	Aug. 15		0.05
Syndicate, Utah	Sept. 18	Oct. 14	0.0015
Tarbox, Mont.	Sept. 28	Oct. 28	0.005
Tyler, Ida.	Sept. 12	Oct. 12	0.0015
Umatilla, Nev.	Sept. 18	Oct. 24	0.0025
Uvada, Nev.	Oct. 9	Oct. 26	0.02
West Toledo, Utah	Sept. 12	Oct. 3	0.01
Whale, Utah	Sept. 5	Sept. 25	0.05
Wonderful, Ida.	Aug. 30	Sept. 20	0.001

Stock Quotations

SAN FRANCISCO Sept. 12 Name of Comp.	Bid.
Alta	.05
Andes	.09
Best & Belcher	.06
Bullion	.02
Caledonia	.35
Challenge Con.	.05
Confidence	.15
Cons. Imperial	.01
Con. Virginia	.10
Gould & Curry	.03
Hale & Norcross	.06
Jacket-Cr. Pt.	.07
Mexican	.17
Occidental	.70
Ophir	.24
Overman	‡.04
Savage	.08
Seg Belcher	.02
Sierra Nevada	.31
Union Con.	.68
Utah Con.	.01
Belmont	4.30
Jim Butler	.84
MacNamara	.06
Midway	.30
Mont.-Tonopah	.25
North Star	.17
Rescue Eula	.22
West End Con.	.68
Atlanta	.09
Blue Bell	‡.01
Booth	.13
C.O.D. Con.	.02
Comb. Frac.	.07
D'field B.B.	.02
D'field Daisy	.03
Jumbo Extension	.36
Round Mountain	.37
Sandstorm Kendall	.03
Silver Pick	.20
Central Eureka	.08
Argo	.07
Ariz. Central	.15
Big Jim	1.12½
Lazy Boy	.12
Oatman No. Star	‡.10
Tom Reed	1.60
United Eastern	3.50
United Western	.08

LONDON Aug. 31	
Alaska-Mexican	£1 6s 3d
Alaska Tre'dwell	5 10 0
Burma Corp.	3 5 0
Cam & Motor	0 11 6
Camp Bird	0 8 0
El Oro	0 9 6
Esperanza	0 11 3
Mexico Mines	3 12 6
Nechi, pfd.	0 13 0
Oroville	0 16 9
Santa Gert'dis.	0 12 0
Tomboy	1 2 6

SALT LAKE Sept. 11 Name of Comp.	Bid.
Alta Con.	.27
Black Jack	.05
Colorado Mining	.15
Crown Point	.03½
Daly-Judge	7.75
Emma Cop.	.63
Gold Chain	.16
Grand Central	.62
Iron Blossom	1.47½
Lower Mammoth	.03
May Day	.06
Opohongo	‡.01
Prince Con.	1.45
Seven Troughs	‡.02½
Silver King Coal'n	3.00
Silver King Con.	3.55
Sioux Con.	.09½
Uncle Sam	.02
Yankee	.10

COLO. SPRINGS Sept. 12	
Acacia	.03½
Cresson	5.65
Doctor Jack Pot	.10½
Elkton Con.	.15½
El Paso	.51
Findlay	.03½
Gold Sovereign	.05½
Golden Cycle	2.16½
Granite	‡.73
Isabella	.20½
Jack Pot	.05
Jerry Johnson	‡.04
Mary McKinney	.26
Portland	1.66
Vindicator	1.95

TORONTO Sept. 11	
Adanac	.25
Bailey	.08
Chambers Ferland	.18
Coniagas	4.55
La Rose	.60
Peterson Lake	.21
Right of Way	.05½
Seneca Superior	.27
T. & Hudson Bay	55.00
Temiskaming	.60
Wettlaufer-Lor.	.12
Dome Exten.	.35
Dome Lake	.49
Foley O'Brien	.55
Hollinger	6.90
Jupiter	.31
McIntyre	1.56½
Newray	.65
Porcu. Crown	.76
Preston E. D.	‡.03
Vipond	.40
West Dome	.38

N. Y. EXCH. Sept. 12 Name of Comp.	Clg.
Alaska Gold M.	14
Alaska Juneau	7½
Am.Sm.&Ref.,com.	107
Am. Sm. & Ref., pf.	114
Am. Sm. Sec., pf. A	96
Am. Sm. Sec., pf. B.	85
Am. Zinc	39⅛
Am. Zinc, pf.	78⅜
Anaconda	88⅛
Batopilas Min.	1⅞
Bethlehem Steel	524½
Bethlehem Steel, pf.	138
Butte & Superior	69¾
Chile Cop.	20⅛
Chino	55⅛
Colo. Fuel & Iron	52⅜
Crucible Steel	84½
Dome Mines	24½
Federal M. & S.	22
Federal M. & S., pf.	43¾
Great Nor., ore ctf.	42½
Greene Cananea	50
Homestake	132
Inspiration Con.	61½
International Nickel	45
Kennecott	53¾
Lackawanna Steel	84
Miami Copper	37½
Nat'l Lead, com.	67⅞
National Lead, pf.	110
Nev. Consol.	22¾
Ontario Min.	7
Quicksilver	3¼
Quicksilver, pf.	4
Ray Con.	25½
Republic I&S, com.	66⅞
Republic I&S, pf.	114⅜
Sloss-Sheffield	58½
Tennessee Copper	26⅛
Utah Copper	87⅜
U. S. Steel, com.	104½
U. S. Steel, pf.	118⅜
Va. Iron C. & C.	51

N. Y. CURB Sept. 12	
Beaver Con.	.42
Buffalo Mines	.80
Butte & N. Y.	1⅛
Butte C. & Z.	5½
Caledonia	.59
Can. Cop. Corpn.	1⅛
Cashboy	.06½
Cerro de Pasco	35½
Con. Ariz. Sm.	1 9/16
Con. Copperminies	2⅛
Con. Nev.-Utah	.28½
Crystal Cop.	1
First Nat. Cop.	4⅜
Florence	.75
Goldfield Con.	.78
Goldfield Merger	.08
Granite	.20
Hecla Min.	5
Howe Sound	5½
Jerome Verde	2⅜
Joplin Ore & Spel.	.50
Kerr Lake	4⅜
Magma	16½
Majestic	⅛
McKinley-Dar-Sa.	.59
Mother Lode	.35
Nevada Hills	.16
N. Y. & Hond.	15¾
Nipissing Mines	7½
Oro	.04
Ray Hercules	3½
Rochester Mines	.54
St. Joseph Lead	16½
Standard S. L.	1 9/16
Stewart	.25
Success	.34
Tonopah	5⅛
Tonopah Ex.	5 7/16
Tribullion	⅜
United Zinc	5½
White Knob, pf.	1½
White Oaks	5⅛
Yukon Gold	2

BOSTON EXCH Sept. 12 Name of Comp.	Bid
Adventure	3
Ahmeek	105
Algomah	1⅜
Alloues	69½
Ariz. Com., ctfs.	12¾
Bonanza	‡.25
Butte-Balaklava	1¾
Calumet & Ariz.	70½
Calumet & Hecla	550
Centennial	19
Copper Range	62½
Daly West	2½
East Butte	16½
Franklin	8
Granby	88
Hancock	13½
Helvetia	.25
Indiana	3½
Island Cr'k, com.	44
Island Cr'k, pfd.	90
Isle Royale	30½
Keweenaw	5⅜
Lake	13⅜
La Salle	4
Mason Valley	2⅜
Mass	13½
Mayflower	2½
Michigan	3⅜
Mohawk	90½
New Arcadian	6½
New Idria	13
North Butte	21
North Lake	2
Ojibway	1½
Old Colony	2½
Old Dominion	71⅜
Osceola	91
Quincy	91
St. Mary's M. L.	80½
Santa Fe	2⅜
Shannon	9⅜
Shattuck-Ariz.	30⅜
So. Lake	6½
So. Utah	.20
Superior	17
Superior & Bost.	5
Tamarack	37½
Trinity	6½
Tuolumne	.50
U. S. Smelting	79½
U. S. Smelt'g, pf.	51½
Utah Apex	4⅜
Utah Con	14
Utah Metal	7⅜
Victoria	3½
Winona	5
Wolverine	48
Wyandot	1½

BOSTON CURB Sept. 12	
Bingham Mines	9¼
Boston Ely	1 1/16
Boston & Mont.	.94
Butte & Lon'n Dev.	.60
Calaveras	6
Calumet-Corbin	.02
Chief Con.	1 15/16
Cortez	.25
Crown Reserve	.43
Davis-Daly	2½
Eagle & Blue Bell	1½
Houghton Copper	1½
Iron Cap Cop., pf.	5½
Mexican Metals	.35
Mines of America	2½
Mojave Tungsten	4½
Nat. Zinc & Lead	1 1/16
Nevada-Douglas	1⅜
New Baltic	2½
New Cornelia	15
Ohio Copper	.07
Oneco	.80
Raven Copper	‡.07
Rex Cons.	.26
Rilia	.16
United Verde Ext.	43⅛

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York 1914	1915	1916	London 1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic 1915	1916	London Standard 1915	1916	London Electrolytic 1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	.....	68.915	.....	85.250	.....
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York 1915	1916	London 1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

LEAD

Month	New York 1915	1916	St. Louis 1915	1916	London 1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

SPELTER

Month	New York 1915	1916	St. Louis 1915	1916	London 1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11 582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	.....	13.270	.....	67.841	.....
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

Month	Bessemer‡ 1915	1916	Basic‡ 1915	1916	No. 2 Foundry 1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	17 57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡As reported by W. P. Snyder & Co.